



**Motivations to leave coarse woody debris in private forests  
a survey based study**

Boon, Tove Enggrob; Meilby, Henrik; Andersen, Anne Sofie Kirkegaard

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Scandinavian Society of Forest Economics  
Uppsala, Sweden, May 2014**

**Anders Roos, Lars Lönnstedt, Tomas Nord,  
Peichen Gong, Matti Stendahl (eds.)**

# SCANDINAVIAN SOCIETY OF FOREST ECONOMICS

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# Scandinavian Forest Economics

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## **Preface**

The 2014 Biennial Meeting of the Scandinavian Society of Forest Economics was held in central Uppsala during four warm and sunny days 21-24 May. This year the meeting was also joined by the researchers of the NEWFOREX (EU-FP7) project, focusing on methods and policies for the provision of forest ecosystem services.

The event convened 80 participants altogether, including a large group of PhD students. The organizers were also happy to welcome participants from other European countries as well as other continents - this wider participation did enrich the SSFE meeting's sessions and discussions. During three intense days 70 papers were presented covering a wide range of subjects including business and management, forest policy, forest industry, products and markets, and ecosystem services. Three prominent keynote speakers gave interesting talks on different aspects of forest economics: Professor Nick Hanley (University of Stirling, Scotland, UK), Professor Gregory S. Amacher (Virginia Tech, VA, USA), and Susanne Rudenstam (CEO, Swedish Wood Building Council, Stockholm, Sweden). Despite an extensive scientific program two "in-congress" tours were included, a guided walking tour in central Uppsala and an excursion to "Stadsskogen", the city's main recreational forest where the delegates were hosted by Fredrik Gustafsson and Åsa Hedin, City of Uppsala. The conference dinner was held at the historical Orangery at the Linnaeus Garden with folk music entertainment on the traditional folk music instrument "keyed fiddle" (Sw: "nyckelharpa") by Sonja Sahlström – and several speeches. The post congress tour headed for "Ekolsunds arboretum – a vital 300-yearling" where the delegates were guided by Nils Lidbaum and the dendrologist Börje Drakenberg.

We gratefully acknowledge funding for the conference by the Nordic Forest Research Co-operation Committee (SNS), the Newforex project (EU-FP7), Letterstedtska stiftelsen, the Swedish University of Agricultural Sciences, and Linköping University. The organizers thank Maria Bäckström for valuable help to organize the meeting.

Finally, a warm thanks to all participants for the enthusiasm and fine presentations that contributed to a successful meeting.

*Anders Roos*

December 2014, Uppsala

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## **Full Length Papers and Abstracts**

### **Business Economics of Forestry & Forest Management Planning**

# **The forest-based sector and research – some thoughts on relevance and future prospects**

Hans Fredrik Hoen

Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences, P.O. Box 5003, NO-1432 Ås, Norway, [hans.hoen@nmbu.se](mailto:hans.hoen@nmbu.se)

## **Abstract**

We are 14 years into the 21<sup>st</sup> century. Forest sciences and research, a multifaceted combination of a number of academic disciplines, have existed and developed over several decades. In this note, I first discuss some current societal challenges or “drivers”, then how this relates to forestry and forest industries (the forest-based sector – FBS) as a profession and business. This is followed by a simple check to what degree we researchers (within forest economics and management planning) have dealt with these topics recently. Finally, I give some ideas for research priorities, with emphasis on the area of forest economics and management. The viewpoint is from Norway, a forest-rich country, with a fairly specialised or concentrated forest industry, currently facing large structural changes.

## **Main challenges for the 21<sup>st</sup> century – with particular relevance for the forest-based sector**

The reason for asking this question is that I believe what will make up the agenda for the forest-based sector (FBS) is as much depending on developments and priorities outside the sector as within. On one side this has to do with shifting demand for forest-based products and services, due to shifts in consumer preferences and competition from new and innovative competitors, such as communication paper is facing versus digital media platforms. Another issue is related to changes in values, priorities and beliefs in the public, e.g. a persistent and growing interest in environmental services from forests (biodiversity) and diminishing acceptance of the production orientation inherent in timber growing and harvesting. The topic of the question, “main challenges”, can be answered in different ways. One tempting approach would be to simply present a subjective list. Another would be to widely sample information from governmental and other influential political bodies, media and scientific journals and systemize this with quantitative, and seemingly objective, tools. A third would be to select the policy priorities of one or a few, authoritative or representative, institutions or decision bodies.

In this note we will look at policy statements and documents of three different political bodies; United Nations (UN), European Union (EU) and the government of Norway. I’ve simply visited their respective websites and with a few keystrokes, tried to identify top political priorities and statements.

### **United Nations (source UN website)**

The UN website lists five areas on top: Peace and security, Development, Human Rights, Humanitarian Affairs and International Law. This gives a strong clue to the priorities and areas of activity within the UN system. Peace and security, human rights, aid, development and poverty alleviation are prioritized areas of the UN. Of highest relevance for the forest sector is the Development area, under which the Millennium Development Goals (MDG) to be reached by 2015, were developed. The MDGs were based on the Millennium Declaration of September 2000. The eight goals are as follows:

- Goal 1 Eradicate extreme poverty and hunger
- Goal 2 Achieve universal primary education
- Goal 3 Promote gender equality and empower women
- Goal 4 Reduce child mortality
- Goal 5 Improve maternal health
- Goal 6 Combat HIV/AIDS, malaria, and other diseases
- Goal 7 Ensure environmental sustainability
- Goal 8 A global partnership for development

Under each goal one or more targets are specified, 18 altogether. Forestry and the forest sector, is not mentioned explicitly in the goals or targets. The “closest hit” is in Goal 7, where the first target listed (target 9) reads: *“Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources”*.

There has recently been a UN-lead process to establish a set of Sustainable Development Goals (SDG) based mainly on outcomes of the RIO+20 conference and the MDGs. The process involved a so-called open working group (OWG), where some 30 selected countries or groups of countries participated. The OWG identified 17 SDGs, with a number of sub-areas under each (169 in total), in their outcome document (dated July 19<sup>th</sup> 2014) which has been forwarded to the UN General Assembly. Forests, forestry and the FBS is mentioned explicitly in the proposed SDG 15 *“Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”*. In addition, the word ‘forest’ appears ten times in the proposed text, once related to water provision and sanitation (SDG 6), and nine times related to SDG 15. *Conservation, restoration and sustainable use* are mentioned concurrently (15.1), an ambition of increasing afforestation and reforestation is expressed, however with the open formulation of x% (15.2), the need of financing sustainable management of forest resources and help developing countries build up their capacity to implement sustainable forest management (15.b). It is worth recognising that in this process the number of goals more than doubled, from eight to seventeen. SDGs are expected to be adopted as the follow-up and continuation of the MDGs. It remains to be seen whether all the seventeen proposed SDGs will “survive” the further UN-process to be concluded by the General Assembly in September 2015.

Based on this inquiry, we may conclude that forestry and the FBS are currently not among the top areas with utmost visibility in the UN-system. However, there proposed SDGs give the FBS a much clearer role and more distinct position compared with the MDGs and also the term sustainable use adds a different dimension compared to the wording in the MDGs. Further, we should recognise that also other UN-supported processes are ongoing, with the aim of developing, renewing and promoting the FBS and its development into the green economy (e.g. The Rovaniemi-declaration: Action Plan for the Forest Sector in a Green Economy (UN-ECE and FAO 2013)). Finally, it should be recognised that climate change (CC), explicitly taken up in SDG 13 *“Take urgent action to combat climate change and its impacts”*<sup>1</sup>, has a much more prominent and clear role in the proposed SDGs compared with the MDGs.

### **European Union (source European Commission website)**

For the EU I found it most relevant to access the website of the European Commission (EC). EC is the body that proposes new legislation to the European Parliament and the Council of the European Union. EC has, in other words, a key role in developing and proposing new policies for the EU. From the EC-website, one easily finds link to the current growth strategy of the

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<sup>1</sup> Acknowledging that the UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change

union, EU 2020, which points at three priorities: smart, sustainable and inclusive growth. A strong emphasis is put on research and education. Horizon 2020 (HZ 2020) is the current research and development programme of EU, operating from 2014 to 2020 with a total budget of nearly €80 billion. HZ 2020 is structured on three pillars:

I Excellent Science

*“Activities under this Pillar aim to reinforce and extend the excellence of the Union’s science base and to consolidate the European Research Area in order to make the Union’s research and innovation system more competitive on a global scale.”*

II Industrial Leadership

*“This pillar aims to speed up development of the technologies and innovations that will underpin tomorrow's businesses and help innovative European SMEs to grow into world-leading companies.”*

III Societal Challenges

*“Horizon 2020 reflects the policy priorities of the Europe 2020 strategy and addresses major concerns shared by citizens in Europe and elsewhere.*

- *Health, demographic change and wellbeing;*
- *Food security, **sustainable agriculture and forestry**<sup>2</sup>, marine and maritime and inland water research, and the **Bioeconomy**;*
- ***Secure, clean and efficient energy;***
- ***Smart, green and integrated transport;***
- ***Climate action, environment, resource efficiency and raw materials;***
- *Europe in a changing world - inclusive, innovative and reflective societies;*
- *Secure societies - protecting freedom and security of Europe and its citizens.”*

These policy priorities reflect what the 28 member states of EU have agreed on. Research and innovation is given high priority in order to stimulate the recovery of the overall economy within the union, even more so after the recession from 2007/2008 and onwards. The two first pillars of HZ2020 *Excellent science* and *Industrial leadership* are general in their approach. Being within the applied and sometimes multi- or interdisciplinary fields of the science landscape, forest scientists may find it difficult, but not impossible, to effectively navigate itself to strong positions in scientific excellence in the classical sense. On the other hand, it might be argued that the FBS have a quite well developed tradition of collaboration and communication between academia (forest sciences) and management and industry. Thus, while forest sciences may face slippery grounds in terms of classical scientific excellence (pillar I), it might have a stronger position in terms of collaboration with users and bringing results from research to business innovations and to “the field” (pillar II). Finally, the third pillar *Societal challenges* points at seven identified thematic areas of priority. Four of these, bullet points 2, 3, 4 and 5, have high relevance for the FBS and vice versa. In 2012 EC published a white-paper on the bioeconomy (EC 2012), followed by documents specifically addressing the FBS in 2013 (EC 2013a,b). Together, these documents strengthen the impression that there are great opportunities and policy support for developing a relevant and vital FBS for the future.

### **Norwegian Government (source Norwegian Government website)**

Finally, I move to the national level with Norway as my example. The current government of Norway came into office in October 2013. It is a two-party<sup>3</sup>, conservative, minority government. It is ruling on the basis of an agreement of cooperation and support with two other<sup>4</sup>

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<sup>2</sup> Bold font added to these bullet points

<sup>3</sup> The government is formed by the Conservative Party (Høyre) and the Progress Party (Fremskrittspartiet).

<sup>4</sup> Supporting parties are the Social liberal party (Venstre) and the Christian Democratic Party (KrF).

centre-conservative parties. The two parties in government issued a document dated 7<sup>th</sup> of October 2013, specifying the political platform (PP), on which the government will base its policies. The document, 76 pp altogether, starts with an introduction and then lists 8 priority-areas. These are general statements of the kind: “*The competitiveness of Norwegian companies*”, “*Knowledge as the key to opportunities for all*” or “*The government will build up the country*”. This is followed by sector-oriented chapters. Each of the chapters has one or more sections with the heading “*The government will*” (*TGW*) stating priorities and modes of action for the government. A text-search through the document for the word ‘forest’ gives 21 hits, where one is irrelevant in our context.

‘Forest’ first occurs in chapter 5 *Economy and industry*, being mentioned under the sub-chapter *Manufacturing industry and the mineral industry*. One out of six bullet points under the heading *TGW* reads: “*Seek to introduce new sources of capital for product development and innovation in the wood processing industry, including allowing the Forest Trust Fund to be used for investments in industrial processes*”. In chapter 6 *Fisheries and agriculture*, ‘forest’ is mentioned 14 times. A separate *TGW* lists 7 bullet points for forest industry and forestry:

- “*Draw up an integrated strategy for the forestry value chain.*”
- *Promote increased harvesting of forests.*
- *Lower the tax rate on profits from the sale of forestry operations to the capital taxation rate.*
- *Strengthen private forestry by selling forested area from Statskog corresponding to the amount purchased by Statskog in recent years.*
- *Give greater emphasis to climate policy objectives in the management of Norwegian forests.*
- *Adapt the transport regulations for timber as far as possible to meet competition from Norway’s trading partners.*
- *Seek to establish new sources of capital for the development and profitable production of new wood-based products, for example by allowing the Forest Trust Fund to be used for investments industrial processes.*”

Finally, ‘forest’ occurs 5 times in chapter 13 *The environment and climate*. In the sub-chapter *Environment* one bullet point under *TGW* reads: “*Strengthen voluntary conservation of woodland and forests*”, while the sub-chapter *Climate* has a paragraph on *Norway’s International Climate and Forest Initiative*, stating that the government will continue this initiative “*... with the aim of achieving long-term results*”.

The priorities of the government should be seen in light of the recent developments and current structural challenges facing the Norwegian FBS. Declining value creation and competitiveness are challenging the sector; shutdowns of several sizeable pulp and paper mills have since 2005 halved this sub-sector’s capacity, due to reduced demand induced by shifts to digital media platforms and growing supply and competition from emerging economies. With its high degree of product specialization on wood-containing printing paper, the Norwegian pulp and paper industry has been especially hit by the market shifts. From being a relatively large net importer of wood, Norway in 2013 exported about 1/4 of the harvest. At the same time the growing stock is increasing continuously. From around 1925 to 2012, the growing stock on the productive forest area in Norway has tripled to above 900 Mm<sup>3</sup> stemwood (without bark). Annual growth has increased from about 12 Mm<sup>3</sup> to more than 25 Mm<sup>3</sup>. Removals have been remarkably stable, and fluctuated around 10-12 Mm<sup>3</sup> in the same period. Thus, from a timber resource point of view, there are sizeable opportunities for new uses of the forest resources in Norway.

From this simple review of policy statements, revealed by visiting webpages of three international or national political bodies, it seems clear that there are current international drivers or political topics, with clear relevance for the FBS.

I choose EU as the “guiding star” for my further elaborations. Based on the top priorities in the HZ2020 third pillar, *Societal challenges*, four areas stand out as priority areas for the FBS in a strategy and effort to improve its societal relevance and contribution. These are by no means in contradiction with the priorities of the Norwegian government for the FBS as presented above. I have rewritten these into:

- Food production and material supply (food & fibre)
- Clean energy
- Green transport
- Climate and environment

In the next chapter I will briefly elaborate on how these areas relate to the FBS.

### **More on the relevance of, and for, the FBS**

Albeit we have listed four different priority areas, they are connected in several ways. Policies and activities to increase food production will typically have implications for land use with effects on the provision of environmental services or deforestation. Vice versa, repercussions can take place, as policies to increase bioenergy supply may cause negative impacts on food production or if a policy to increase forest biomass production to supply raw material to a growing biorefinery industry negatively impacts other ecosystem services such as recreation. However, we will discuss each of the priority areas and mention some of the relevant linkages concurrently.

#### **Food production and material supply**

This area directly points at questions and challenges about allocation and use of land, how new materials and products can be provided with the basis in forest biomass, and the sustainability and production potential (short term – long term) of forest and land areas. The latter has clear connections also with area four (climate and environment). IPCC in its fifth assessment report (AR) conclude that afforestation and reforestation must play a vital role in CC mitigation in order to reach the 2° C target (IPCC 2014). This will have impact on land use, possibly in conflict with other ecosystem services (e.g. biodiversity), and thus connects to the last of the four areas. For the FBS, as for any industrial sector or economic activity, continuous product development, innovation and increased productivity are essential to uphold or increase market shares. New and emerging wood-based products include prefabricated building modules, cross-laminated timber elements for construction, wood-plastic composites (WPC), nano-materials, chemicals, new paper-qualities (e.g. in packaging and tissue), textiles from cellulose, lignin-based carbon-fibres, new fibre-based products (wood-fibre insulation) or bioenergy in different forms (Cai et al. 2014). Finally, it is worth mentioning that in some areas of the world, food and fibre are produced jointly in agroforestry systems. Non-timber forest products as berries, nuts, mushrooms or honey have local importance and fish and wildlife also play important role for many landowners with significant market potentials.

#### **Clean Energy**

Globally, biomass used for energy still accounts for about half of the biomass removed from forests. With growing concerns about effects of CC, bioenergy has been advocated as a route to mitigate and combat CC. EU has imposed strong policy incentives and targets in order to increase bioenergy volumes in the 20-20-20-strategy. Countries such as Finland and Sweden have been identified as key actors in increasing their supply of bioenergy for EU to reach its



targets. There has been a lively debate on to what degree increased removal of forest biomass for energy can be justified as climate neutral or not (Pelkonen et al. 2014) and the issue is still up for discussion and debate. Several studies have concluded that the future demand (up to 2030) for biomass to energy-conversion will increase sharply in the EU-area (EUwood – Mantau et al. 2010; EFSOS II – UNECE/FAO 2011). Anyhow this view has been challenged and claimed to be based on too simplistic assumptions, not taking basic market forces adequately into account (Solberg et al. 2014). More research and analyses is needed on these topics. Finally, IPCC in AR5, report III (IPCC 2014), conclude that bioenergy with carbon capture and storage (BECCS) forms an essential component of the CC response strategies for reaching the 2°C-target (IPCC 2014; see also Azar et al. 2010; IEA 2011; Krieglner et al. 2013)

### **Green transport**

The transport sector globally accounts for about 20% of total energy consumption (EIA 2014). Any policy to effectively mitigate CC will have to shift the supply of energy to transportation, from fossil to renewable energy bearers. Liquid biofuel, from sustainably managed feedstocks such as forest biomass, can here play a role (EBTP 2014). Especially in aviation and parts of heavy transportation, liquid biofuels seem to be the only realistic alternative on a medium term (maybe up to 2030 – 2050) (Rambøll 2013). If conversion technologies develop along with climate policies, this can open up markets with large volumes and significantly impact the competition for fibre and raw material from forests.

### **Climate and environment**

The connections between challenges related to “climate and environment” and the FBS are many. In this context, the FBS can be seen as a “guilty”, “victim” or “saviour” or a combination of these.

Forests provide multiple ecosystem services in the terminology used by the Millennium Ecosystem Assessment (NOU 2013). Traditionally, the non-timber goods and services were by many (especially forest managers and landowners) considered as byproducts of timber, but a growing concern in society that timber is supplied on the detriment of other important ecosystem services has become a significant policy driver. Furthermore, carbon sequestration and storage are currently a main issue in discussions of forest management and conservation, and the REDD+-policy developing since 2007-2008 illustrate how forest ecosystems and their management have taken a prominent position in global CC-mitigation-policies. Thus, policies and institutions need to be developed to achieve appropriate balances, see e.g. Amacher et al. (2014). In this perspective the FBS is seen as “guilty”.

Anticipated environmental changes or shocks, such as CC, may influence the capacity and robustness of ecosystems and their potential for long-run and sustainable bioproduction. Changes in average or episodic incidents of temperature, precipitation (drought or flooding), frequency and intensity in windstorms, snowfall or “ice-storms” may impact the stability of forest ecosystems directly. Such changes may also have indirect effects, in altering the conditions for other ecosystem agents such as e.g. fungi and insects, which again may have strong impacts on ecosystem resilience. This point to the necessity of achieving a deeper understanding of these interactions and developing management to better adapt to environmental changes and shocks. How can we through management make forest ecosystems productive, robust and resilient? In boreal forest management, with its long production cycles (rotation ages), decisions and choices in regeneration is of particular importance since flexibility and modes of choice for the whole rotation is a consequence of the initial stand structure after regeneration. Another topic is what is the appropriate level of analysis; the individual tree, the stand or the landscape. At the stand level mixing species and having trees with multiple ages might improve within-stand stability, but this could be different looking at whole landscapes.

These are questions and problems involving considerable risk and uncertainty and should be addressed accordingly. In this perspective the FBS is seen as a “victim”<sup>5</sup>.

As already mentioned forests, forest management and increased use of forest-based products may take an important part in mitigating or combatting environmental changes such as the #1 challenge of this century, CC (IPCC op.cit.). Forests also play important roles in stabilising local climate, having an important role in hydrological cycles providing fresh and drinking water many places, acting as a recipient of pollution or being an important arena for daily or advanced “wilderness-oriented” recreation. In this perspective the FBS can be seen as the “saviour”.

These three perspectives cannot be seen isolated from each other, but should rather be seen as supplementary interpretations or approaches under this priority area. Together they point in directions of increased competition for land: land for production of biomass (food & fibre), land for securing biodiversity, land for human livelihood, recreation and comfort, and land for storing biogenic carbon. Analyses of efficient land use, land use conflicts and studies of how to design policies for more appropriate balances among competing land uses will be in high demand (Ollikainen 2013). Another unifying issue, always relevant when studying and analysing (boreal) forestry with its long production cycles and investment horizons, is the cost of capital and the required rate of return which investments in regeneration, forest management and growing stock (tree capital) are compared (or compete) with. Over the last couple of decades there has been growing interest in questions of how to analyse really long-term projects (of 100 years or more), mainly due to research and policy development regarding CC. Is classical exponential discounting a relevant tool for project appraisal of such long-term projects? See e.g. Hepburn (2007) or Price (2008) for discussions of this in a forestry context.

## **A simple bibliographic search**

To what degree have the research community dealt with these topics and challenges in recent years? I have done a simple bibliographic search to find some indications of this. First, I checked the latest issues of the series Scandinavian Forest Economics (SFE), the proceedings from the biannual meeting of the Scandinavian Society of Forest Economics (SSFE), from the meetings in 2006, 2008, 2010, 2012 plus the list of presentations according to the official program of the SSFE-meeting in Uppsala, May 2014. Secondly, via Science Direct I searched titles, keywords and abstracts in the two scientific journals: Forest Policy and Economics and Journal of Forest Economics, for the period 2010 to May 2014. For each of the four priority areas I subjectively selected one or more identifying words or phrases (parts of words) for which I did a simple text-search. The words or phrases I selected were as follows:

- Food production and material supply (food & fibre): Land; Product; Material
- Clean energy: Energy
- Green transport: Transport
- Climate and environment: Climate; Risk; Uncertain; Discount

The results are given in figures 1 and 2, respectively.

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<sup>5</sup> It may also be argued that the FBS may be the “beneficiary” in this context. The strong political support to stimulate the emergence of the green economy or bioeconomy is one line of argument, while another is that CC may benefit and enhance conditions for forest production in some regions of the world, like the boreal forests in Northern Europe.

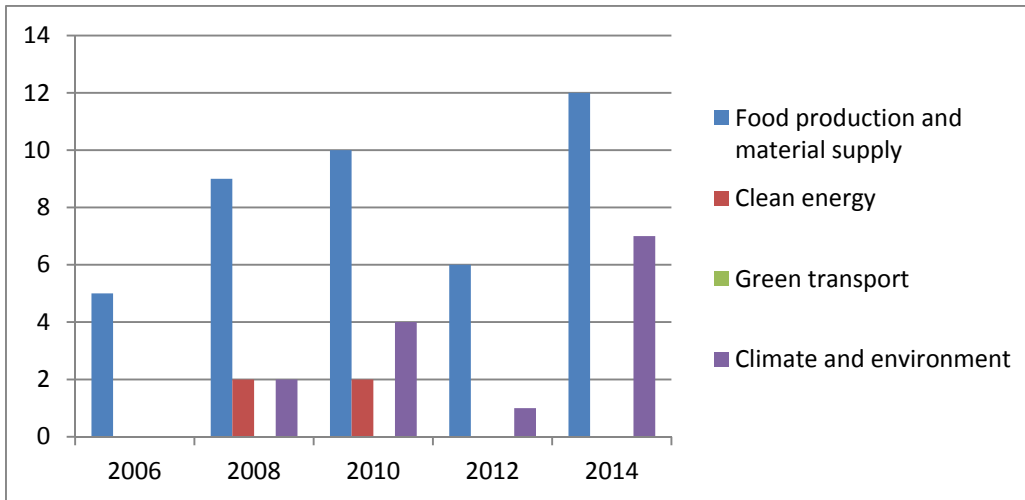


Figure 1. Occurrence of selected words or phrases connected to the four priority areas in SFE 2006 – 2012 and the presentations at the SSFE-meeting 2014

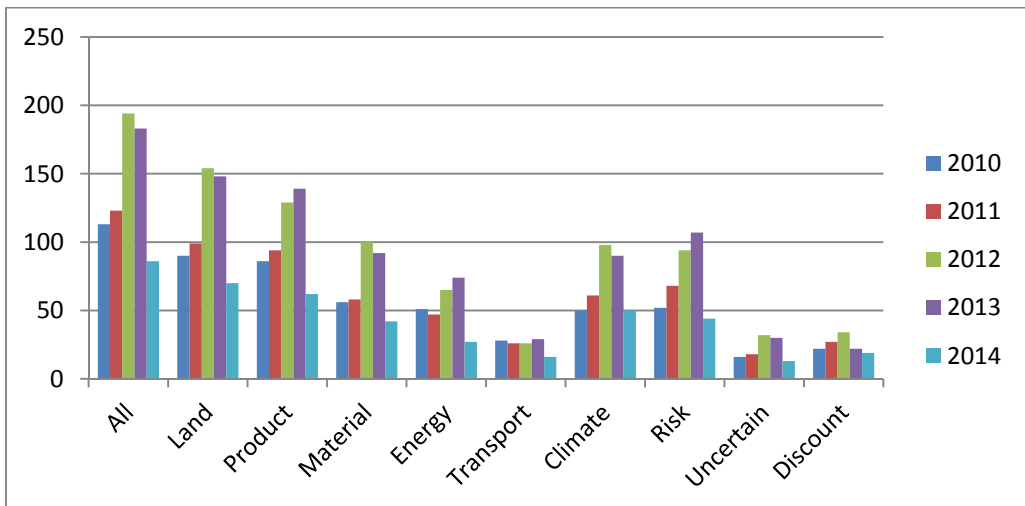


Figure 2. Occurrence of selected words or phrases connected to the four priority areas in Journal of Forest Economics and Forest Policy and Economics 2009 – May 2014

The way the two searches were done differ somewhat. In the SFE-search, occurrence is counted once for each priority area, even if more than one of the indicator-words or -phrases occurs within the same title. For the search in the two journals occurrences of each phrase is counted. The column all, give the number of articles with one or more phrase occurring.

The pattern is similar. Most occurrences are found in the first priority area ‘Food production and material supply’ and second comes ‘Climate and environment’. There does not seem to be any clear trend or change in the relative level of occurrence among the priority areas. Energy has surprisingly few occurrences taking into account the large interest in the topic of forest-based bioenergy over the last ten or more years. Transport comes out with clearly the lowest number of occurrences in both cases. From this we can conclude that the research activity, as expressed in published work in these channels, have been less occupied with clean energy and green transportation than what is called for from policy makers.

## Concluding remarks - some rewarding research topics

First, I believe that in the current situation, there are large opportunities, with research from our field, to contribute with relevant, new knowledge in order to support policy and decision making directed towards the FBS. With CC as a main driver, there is a clear call for research helping policy-makers to pave the way for the FBS into the bioeconomy or green economy (Ollikainen 2013). This is justified by a brief inspection of priorities within Horizon 2020 and also at national level in Norway as well as by comparing the proposed SDGs with the MDGs of the UN.

Below I list some topics and research questions I believe will be rewarding for our community (forest economics and management) to address.

### a) **Development or transition to the bioeconomy:**

*New products, materials and services:* Technology foresight studies. What are emerging technologies? What are the market dynamics and prospects for existing and new products and services? How will the competition for raw material (forest biomass) to different industrial processing develop? Can the FBS deliver cost-efficient liquid biofuel to parts of the transportation sector in sufficient volumes?

*Sustainability and production of biomass in the long run:* Provide balanced prognoses of future biomass production. What are the production potential and possibilities to provide biomass from forests in the (short and) long run? Will the cascading principle and more recycling of wood from different products pave its way deeper and broader into the FBS?

*Policies to support such a transition:* Policy analyses and policy design. What are likely developments of the policy-arena? How may the political landscape develop? What kind of policy programs or support may most effectively support a transition of the FBS into the bioeconomy? How to foster a process of *creative destruction* so that the viable parts of existing values chains survive and develop, concurrently with the evolution of new and emerging products and services?

### b) **Risk and uncertainty**

*Development of new businesses and industries:* Major investments and significant capital is needed to build and restructure processing industries within the FBS. How can the FBS attract risk-capital and new investors to contribute to the much needed restructuring and renewal in the current economic environment?

*Consistency/efficiency and (long) time horizons:* The hunt for efficiency, productivity gains and improved competitiveness will not disappear. Investment programs and strategies need to be based on robust and realistic analyses of projects and demonstrate sound profitability. Investments in the FBS with really long time horizons must compete with business opportunities with 5 to 10 years (and even shorter) horizons. How to do relevant, realistic and consistent project appraisal (including assessment of risk and uncertainty), so that the typical long term investments in the FBS may be compared with more short-lived alternatives?

*Robustness and “portfolio-thinking”:* Development of robust strategies to tackle CC, other environmental shocks and simultaneously respond to the demands of the future green economy or bioeconomy. Within stand diversification compared with intensification and segregation (zoning) – what gains overall robustness and productivity?

### c) **Joint production**

*Ecosystem; sector and general approaches (climate change, biodiversity) and analyses of trade-offs:* Forestry and the FBS need to see its land use in the broad perspective (understand the role as “guilty”). Analyses where land use for all different ecosystem services are included,

compared and evaluated together with other, competing land uses such as food production, urban and rural development and infrastructure, will be warmly received.

*Ecological responses and ecological “production functions”*: Study the robustness and scientific basis of actions taken and criteria applied in order to balance timber production versus other important ecosystem services from the forest area. How effective have policies to promote e.g. buffer zones, set-aside areas or continuous cover stand management turned out to be in order to benefit and secure other important ecosystem services from forests than timber production? How much is achieved and what is the likely (long-run) ecological impact?

*Forest management supporting the bioeconomy*: Analyse effects of, and adaptation to, CC on forest biomass production (the role as “victim”) as well as the potential contribution from the FBS to mitigate CC (the role as “saviour”). What kind of forests to establish when climate is changing (rapidly)? What kind of biomass and fibre to grow in order to supply raw material for industrial processes in the future? How best manage old-growth or over-mature timber stands when climate is changing?

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# Treating irregularities in carbon price and discount schedule: resolving a nightmare for forest economics?

Colin Price<sup>1</sup> and Rob Willis<sup>2</sup>

<sup>1</sup> Colin Price Free-lance Academic Services, 90 Farrar Road, Bangor, Gwynedd LL57 2DU, UK, c.price@bangor.ac.uk

<sup>2</sup> Moelyci Environmental Centre, Lon Felin Hen, Tregarth, Bangor, Gwynedd, LL57 4BB, UK, rob.willis@cooptel.net

## Abstract

Classical forest economics posits an optimal sequence of constant rotations. Projected variation of discount rate changes optimal rotation through time, as does projected relative price change for multiple products. These factors greatly increase the difficulty of calculating NPV of multi-rotation forestry projects, for traditional timber production or for multiple purposes. If, however, a given schedule of time-dated carbon prices is used, combined with set discount rates, a spreadsheet solution is practical and feasible. A given sequence of rotation lengths can be evaluated and compared with alternative sequences. Beyond when both discount rate and carbon prices are projected to stabilise, classical formulas can be used for perpetual series of constant rotations. Among the consequences of using government-mandated values are: very high value for most commercial forest crops; very long optimal rotation; favour for no-thinning regimes. Bizarre consequences include a negative carbon account for regimes which are carbon-neutral; a positive or negative value of a regime, depending on start date; a crop's being more valuable if infected with a serious disease.

**Keywords:** irregular cash flows, carbon price, discounting, tree disease

## Introduction

Classical forest economics is based on regular sequences of cost and benefit, with prices normally constant. The necessary calculations are aided by compact formulas for cash flows repeating over a period – and, in the limit, perpetually. For example:

$$\left[ \begin{array}{l} \text{Discounted value of} \\ \text{perpetual series of} \\ \text{rotations of } T \text{ years} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Discounted value} \\ \text{of first rotation} \end{array} \right]}{1 - e^{-\rho T}} \quad \text{where } \rho = \text{discount rate}$$

Under these conditions, the optimal sequence of activities comprises repeated rotations of constant length, often called the Faustmann rotation.

How readily we forest economists take such convenient formulas and such conventional assumptions for granted! How they pervade the pages of our journals! But how easily they are invalidated by governmental edicts about appraisal procedures! This paper outlines a spreadsheet approach to evaluating a sequence of rotations when the key values of discount rate and price of carbon transactions (fluxes) change irregularly through time. It shows how the changes can be encompassed, for forest crops grown over as many rotations as may reasonably be desired. It notes some consequences for forestry of the UK government's approach; then examines some bizarre results that arise from using such irregular values, particularly the possibility that the carbon account of forestry may be negative, even though the tree crop returns no more carbon to the atmosphere than it fixes initially. Finally, some applications to appraisal of a recently-serious disease of pines are given.

## Declining discount rates: sophistication or frustration?

The UK government and that of France have recently advised that discounting in public project appraisal should use a schedule of declining rates (Treasury, undated; Lebègue et al., 2005). The UK's prescribed annual rate declines from 3.5% for the first 30 years, 3% for 30-75 years, 2.5% for 75-120 years, 2% for 120-200 years, 1.5% for 200-300 years, and 1% thereafter.

For classical forest economics, application of these rates is highly disruptive.

- ❖ It invalidates equations into which a single discount rate can be substituted over perpetual time.
- ❖ As the rate varies discretely and irregularly, equations in continuous time are differentiable and integrable only across limited periods.
- ❖ This prevents one-step analytical approaches to long-period optimisation.
- ❖ Numerical time series summations cannot be applied if the series crosses a step between discount rates: tedious, year-by-year calculations are indicated instead.
- ❖ The summation formula for a perpetual series of rotations is inapplicable.

Is there a forest economist on earth whose past work would not be compromised by these restrictions?

The most-addressed problem in theoretical forest economics, that of the unique optimal rotation (see Newman, 2002), no longer has a solution. Instead, as discount rate declines, so optimal rotation lengthens. Nor is the optimal schedule of lengthening rotations susceptible to either algebraic or simple numerical solution. Instead, a cumbersome forward-recursive simulation solution is required, and it is uncertain whether this solution will be consistently maintained as time moves forwards (Price 2011). A similar result arises when the relative prices of products change (Price, 2012a).

Moreover, even a stipulated silvicultural regime cannot be evaluated by short-cut formulas for recurring cash flows – particularly if that specified regime is to be repeated in perpetuity. Instead, onerous year-by-year calculations are required even for a single rotation, and the value of each subsequent rotation can only be found by repeating these calculations.

## Climate change: a new analytical nightmare

The irregular discount profile creates a nightmare for valuing continuous flows of cost or benefit. Particularly this is so for the social cost of climate change, as would be imposed on the world economy by flux of CO<sub>2</sub> into the atmosphere (Clarkson and Deyes, 2002; Stern, 2006). In deriving this cost, several exponential processes interact (Price, 2012b). Despite these processes' complexity, the continuously integrable form of the underlying equations allows compact results: for example, the capitalised value of an individual carbon flux could be represented as an equation embodying several exponents, variously combined.

$$P_0 = C_0 \times \left( \frac{1}{\rho} - \frac{1}{\theta + \rho} \right) \times \left( 1 - \sum_{b=1}^{b=5} p_b \times \left( \frac{\mu_b}{\mu_b + \rho} \right) \right)$$

where

$P_0$  = carbon price at time 0

$C_0$  = economic damage under present conditions caused by one additional tonne of carbon in the atmosphere

$\rho$  = carbon discount rate (normal rate, minus rate of carbon price rise)

$\theta$  = oceanic thermal adjustment coefficient



$p_b$  = proportion of atmospheric CO<sub>2</sub> “allocated” to carbon sink  $b$   
 $\mu_b$  = uptake coefficient from the atmosphere into sink  $b$

Although more elaborate than the naïve exponentials of decline promulgated by Nordhaus (1992) and criticised in Price (1995), this is still a compact formulation for a base carbon price. A price so derived was often projected to increase exponentially through time: particularly, with size of the world economy, which was implicitly deemed to be affected proportionately by temperature (Cline, 1992; Fankhauser, 1995). This rate of increase can be embedded in the carbon discount rate. Single carbon-relevant events, such as timber harvest, can be valued by one equation, in which base carbon price, the carbon discount rate and timber decay rates are arguments.

With an irregular discount profile, however, deriving a price for a carbon flux in any year is daunting: each ensuing cost to the world economy must be assessed and discounted year-wise and summed, onwards to the time (300 years in future for the UK) when the discount rate stabilises. Price (2012b) details the problems of encompassing all the chains of consequence, for each carbon flux. For each year’s flux, the lagged consequences for the world economy, via uptake of CO<sub>2</sub> into sinks and thermal inertia, must be projected for each individual future year, and discounted with the mix of discount rates appropriate to that year. The irregular discount steps prevent these consequences being combined into a single integral.

### **Irregular carbon price schedule: bane or blessing?**

The UK government has recently added a new dimension to the problem. The social cost of carbon approach has been supplanted by one where a price schedule, varying irregularly, is set by the UK Department of Energy and Climate Change (DECC) (2009). The prices are shadow prices, which if used pervasively would meet year-wise targets for reduced CO<sub>2</sub> emissions (DECC, 2013). Prices so derived relate to politically negotiated targets as well as to characteristics of climate systems and economies. They may rise, fall, or stabilise through time. Separate price series are defined for two sectors, “traded” and “non-traded”. The components of each sector seem arbitrarily derived, with forests themselves in the non-traded sector, but certain wood-using industries, particularly biomass burning, in the traded sector (Valatin and Price, 2014). And yet, from a global perspective, the flux of a tonne of CO<sub>2</sub> into or out of the atmosphere affects climate equally, whichever sector the transaction takes place with. By 2030, the series converge, but they continue to rise irregularly thereafter.

One may have a dissenting view on the validity of declining discount rates (Price, 2004, 2005); of distinguishing traded and non-traded prices; and on whether the previously-used social cost of carbon was actually a more rational basis for carbon price. However, appraisals made under contract to the UK government must now use the prescribed values, for both discount and carbon price schedules, even if the results are unwanted ones.

This irregularity of schedules seems further to obstruct any analytical or straightforward numerical appraisal of forestry options. Such is the multiplicity of numerical calculations needed, that only computer approaches are feasible. The spreadsheet approach described below builds on understandings developed during an earlier numerical solution of carbon flux problems in forestry (Price and Willis, 1993).

### **The structural solution**

The initial need is to align time scales for the diverse data. The Treasury discount schedule starts from “the present”. DECC carbon prices are dated in historical time, from AD2008

onwards. A forest crop's formation may start at any future time, or (importantly for analysis of crop disease) may already have occurred, so the baseline time is the current crop's age. All baselines must be made "contemporary": crop age, carbon price and discount rate all must be those in force at the project start. Then, from each baseline, data from relevant files are rolled forwards annually.

Cash flows are discounted by factors compiled from Treasury discount rates for the appropriate period: for example for the first 80 years the factor is

$$\frac{1}{(1+3.5\%)^{30}} \times \frac{1}{(1+3\%)^{45}} \times \frac{1}{(1+2.5\%)^5} = 0.083271$$

Discrete-period discounting format is used, to distinguish this declining discount rate process from the continuous form common in theoretical forest economics: it accords with practice promulgated by UK Treasury (undated).

Irregular discounting and carbon prices preclude the earlier model's compact equations. Instead, annual values for forest carbon increment are credited. At each harvest (thinning or final felling) material is allocated by formula, according to size of tree, among three further carbon pools: large roundwood (LRW), small roundwood (SRW) and non-timber biomass (branches, stump, roots). (A greater variety of products could readily be encompassed in the same structure.) A facility exists for a specified proportion of each product to displace high-embodied-carbon materials, and thus permanently to reduce atmospheric CO<sub>2</sub>. (See Price and Willis (2011) for more details of this.)

Carbon is accumulated into the three product pools at each harvest, and carbon volatilises (decays or burns) from each pool at the pool's assigned rate, irrespective of the time when the original addition was made to the pool. This is mathematically equivalent to applying the same decay rate individually to each time-signed addition to the pool. For greater accuracy, carbon decay should be allocated to the mid-point of the period from  $t-1$  to  $t$ , or continuous discounted carbon accretion and decay could be integrated across carbon stock during the period. (This is possible, because the same carbon price and discount rate prevail *within* the year.) Integration is thus done first across *all sources* of a pool for *a single time period's flux*, rather than across *all time periods* for *a single source*. This yields a net change of sequestered carbon, summed across pools, for each year, allowing compact application of the appropriate carbon price and discount factor for the year.

Variation of discount rates also precludes a multiplier from the NPV of one rotation to that of a perpetual series. Therefore the defined rotation, with its cash flows and carbon fluxes, is repeated in successive sequences of spreadsheet rows, for as many rotations as might be of significance. The usual result obtains, that any effects after 500 years are completely trivial, even with the very low (1%) discount rate prevailing after 300 years.

The result is shown in figure 1: the accumulated discounted value of carbon fluxes fluctuates at first, with growth then decay of crops, but stabilises within four or five rotations, long before the 500-year time horizon adopted arbitrarily for the spreadsheet.

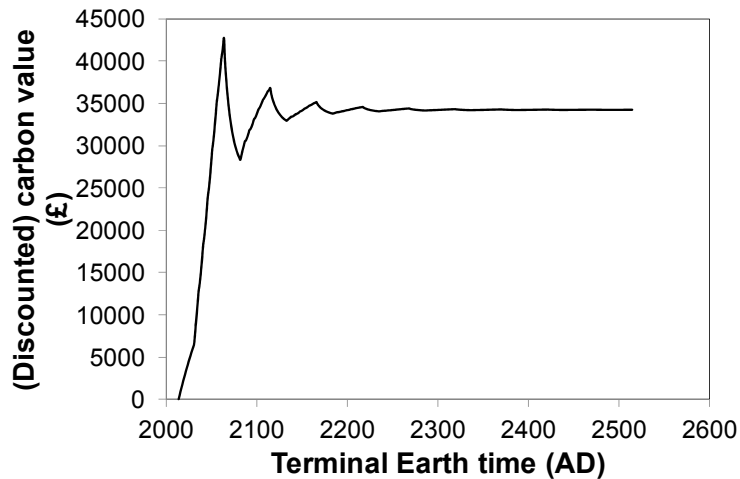


Figure 1. Accumulated value of discounted carbon fluxes, thinned Corsican pine yield class (YC) 14, 50-year rotation

Prolonging the sequence of rotations in perpetuity is technically feasible. Beyond the time when both discount rate and carbon price are projected to stabilise (or no reason is adduced for them to change further), the classical formula can convert the value of the first subsequent rotation to that of a perpetual series of rotations of constant length. That summary value is then discounted by the appropriate factor to the present.

The procedure could use, instead of DECC values, a schedule of prices based on social cost of carbon. These prices would be compiled via a separate line-by-line calculation for each future year, with the appropriate discount profile for the economic effect, in that year, of a particular temperature change. This embodies two-stage discounting:

- ❖ discounting, at period-appropriate rates, the far-future social costs of atmospheric CO<sub>2</sub> flux, back to specified nearer-future dates, so deriving a time-dated carbon price, then
- ❖ discounting the resulting price back further to the appraisal's time zero.

The procedure does not *optimise* (though its structure facilitates manual iteration, or use of the spreadsheet's iteration ability). Earlier simulation models, which have no carbon element, could be adapted to yield a recursive solution. But the procedure described is intended to value a *given* silvicultural regime, as often required by public, corporate and private forestry agents.

## Resulting values and indications

DECC prices are very high, compared with those previously recommended, rising to equivalence of around £1000 per tonne of carbon (*not* CO<sub>2</sub>) by 2100. Predictably, the carbon account for most crops modelled shows remarkably high values: the rest of this paper shows typical results. For high productivity crops values may reach £100,000 per ha. Even low productivity crops on poor sites (e.g. lodgepole pine of YC4 (4 m<sup>3</sup> increment per ha per year)) achieve social profitability. Carbon values overwhelm those of timber production, and heavily outweigh crop formation costs.

There are major consequences for rotation. The values plotted in figure 2 show no optimum, though a maximum NPV finally exists at about 200 years. However, if timber prices increase by a factor of three (as might be expected, in absence of felling of commercial crops), an optimum occurs at about 105 years. Also, if 25% of harvested carbon displaces high-embodied-carbon products, earlier harvesting again becomes carbon-advantageous: the optimum is about 115 years. By contrast with all these, the optimal rotation without carbon values (but using Treasury

discount rates) is 55 years, with NPV only £2500/ha. However, this great prolongation of rotation is partly a function of *high* carbon prices and low discount rates, not just of *irregular* ones (see Price and Willis, 2011). For example, a carbon price of £100 and a constant 3% discount give an optimal rotation of 125 years, with the usual high NPV.



Figure 2. NPV of thinned Corsican pine YC14 on various rotations

High carbon prices have other silvicultural results. Table 1 compares values for thinned and unthinned Douglas fir YC20 on repeated 50-year rotations, showing that high-priced carbon reverses the superiority of crown thinning.

Table 1. Influence of DECC carbon prices on thinning of Douglas fir

Regime	DCF (no carbon)	Discounted carbon value	NPV (including carbon)
Crown thinning	£6,245	£51,355	£57,599
No thinning	£5,427	£58,586	£64,013

### Bizarre outcomes from irregular changes

Some unexpected results, however, do arise simply from irregularity of carbon prices. A single thinned crop of Sitka spruce, YC24, starting from 2010, on a 30-year wind-constrained rotation has a discounted carbon account of -£1,357 (undiscounted carbon account of -£109,320). However, if replacement crops are included, the carbon account becomes positive.

More bizarrely, a single short (15-year) rotation of black poplar has a negative carbon account if planted in 2014 (£-431), or 2019 (-£1016), but a positive one if planted in 2009 (£546), or 2024 (£38), or 2029 (£2200). However, if a crop planted in 2014 is replaced at the end of succeeding rotations, the carbon account is positive (£17,472). From this it may be deduced that afforestation should start with the “second rotation”, in 2029. Contrary to received wisdom, rising carbon price makes replacement crops more important than the first.

Similarly, the sign of carbon value is susceptible to the discount schedule: a single 50-year rotation of Corsican pine YC14 has a negative carbon account (£-23,346) at a constant 1% rate ... but a positive one (£17,056) using the Treasury discount schedule. This result may seem counter-intuitive – very low discount rates surely favour environmentally friendly carbon

sequestration? It is nonetheless logical, because the 1% discount rate emphasises the higher DECC prices prevailing during the period of decay.

Because of the higher price for carbon fixing which prevails later, the second rotation has a positive carbon account (£76,985) with a 1% discount rate. Once again, it seems optimal to omit the first rotation. The second and all subsequent rotations have an aggregate positive carbon account (£154,016).

These bizarre, often unstable, results and many others, all arise from the irregular profile of discounted carbon price.

### Bizarre effects of disease

Some practical results are now summarised in the context of a government-funded project to examine the economic consequences of a disease, *Dothistroma pini*, which presently causes serious damage to pines in the UK.

Take a 25-year-old unthinned crop of lodgepole pine, YC8. Wind constrains its rotation to 50 years. Because of low productivity, at the rotation end subsequent “rotations” are of “bare land” for conservation, a not-uncommon prescription in the UK. However, the disease may kill the crop before planned felling. Figure 3 shows NPV of future cash flows and carbon fluxes, discounted to the present age, of various rotation lengths. Negative NPVs of short rotations are due to low discounted carbon prices for fixing, followed by rising discounted carbon prices for decay. Because of the still-relatively low price of decay, and the small existing volume *available to decay*, infection and felling at 38 is better than the disease-free, wind-constrained norm of 50. If the rotation *could* exceed 50 years, fixing then occurs at a much higher discounted price than the subsequent decay, and the NPV improves.

The result is more “normal” for a rotation only begun in 2014: more fixing in the early rotation is included, and decay occurs in periods of lower discounted price. NPV improves from 23 years onwards, and is positive on the wind-constrained rotation of 50 years. What has changed importantly is *not* the initial age of the crop in itself, but the profile of carbon prices during its remaining transactions with the atmosphere.

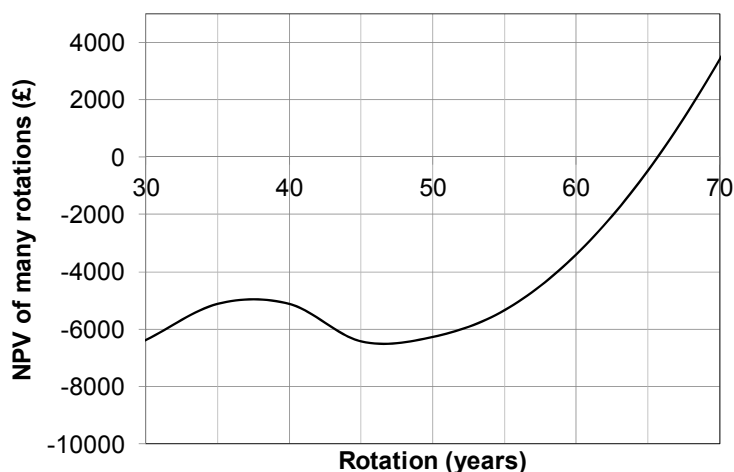


Figure 3. Lodgepole pine YC 8, age 25, DECC prices; various rotations

The bizarre fact here is that optimal feasible rotation changes according to crop age. Seen from age 25, 38 is optimal: seen from age 0, NPV is increasing rapidly at age 38. Shift of base year conventionally shifts absolute NPVs of different rotations, but not their rank order. To repeat, this difference is caused by the irregularity of carbon prices: particularly, of *discounted* carbon prices. By contrast, with a constant £100 carbon price, a 50-year rotation is superior to any shorter one, whether the starting age is 25 or 0.

For Corsican pine the disease usually slows growth, rather than killing trees. The following cases use a thinned crop of YC14, infected at age 30 with the effect of slowing growth to 40% of the previous rate. Normal rotation age is 55 years. The managerial response to disease is to delay subsequent thinning and felling, such that sizes of trees and volumes at each harvest are the same as for an uninfected crop: but the time scale of crop growth is extended.

In the first case (figure 4) the land is abandoned for silviculture after felling. The solid curve is the NPV of a “normal” crop; the dashed curve is that for an “infected” crop. The infected crop performs better, whatever its current age, because the discounted cost of carbon decay at the end of the rotation is postponed and thus reduced by the slower growth.

If planting is delayed for 50 years, however, there is a different balance of discounted carbon prices between fixing and decay, and for most of the rotation it is better if the crop is not infected (figure 5).

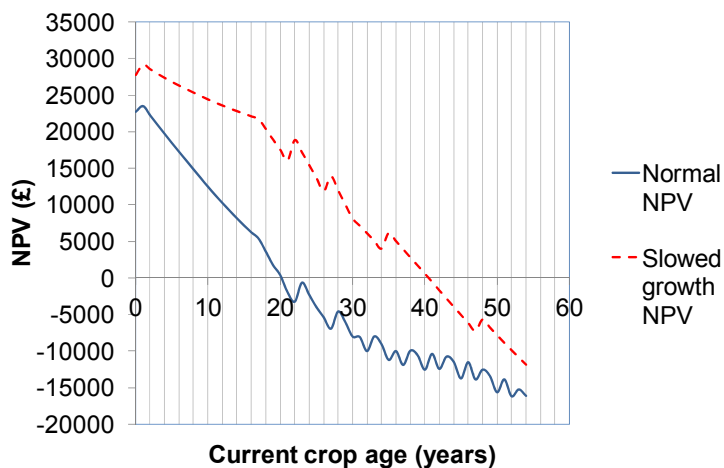


Figure 4. Corsican pine YC14, rotation 55 years, no successor crop, DECC prices; various current ages

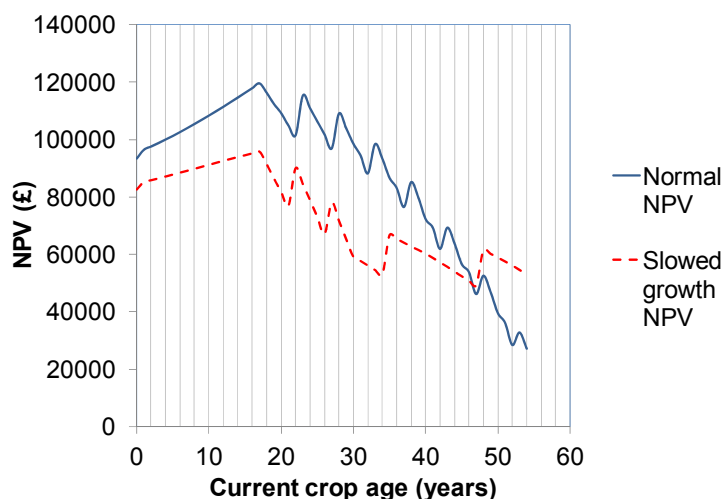


Figure 5. Corsican pine YC14, rotation 55 years, no successor crop, DECC prices, planting delayed 50 years; various current ages

Next, we revert to planting in 2014, but using Douglas fir, also YC14, for all replacement crops (this option accords with current replanting strategy). Now the delay of volatilisation is more-than-balanced by delay of fixing in the following rotations, and slowed growth *reduces* NPV (figure 6).

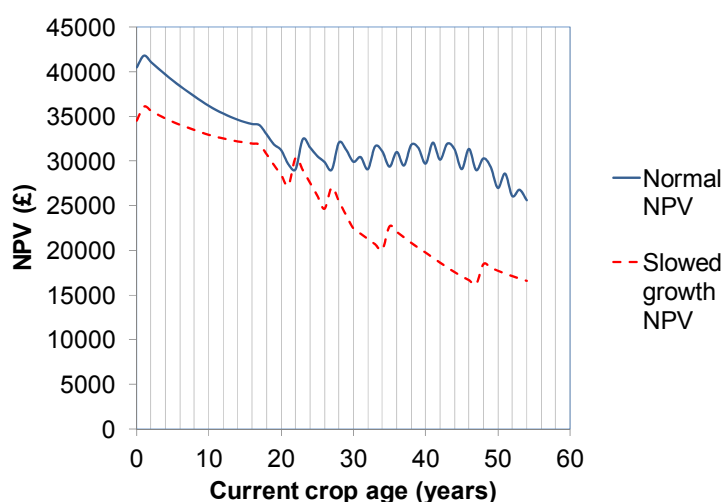


Figure 6. Corsican pine YC 14, rotation 55 years, Douglas fir successor crop, DECC prices; various current ages

That the high performance of slowed growth is due to irregular carbon prices is shown by using a uniform £100 carbon price. With silviculture discontinued after the first crop, only late in the rotation is slowed growth superior, as it still has fixing to achieve, and its decay is delayed (no figure is presented).

With Douglas fir following, slowed growth is never close to competing with normal growth (figure 7).

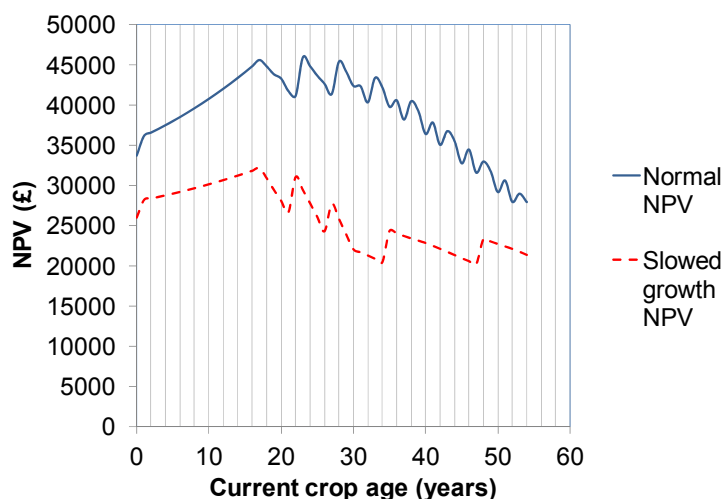


Figure 7. Corsican pine YC14, rotation 55 years, Douglas fir successor crop, £100 price; various current ages

## Conclusions

Declining discount rate and irregularly changing carbon price seem to pose near-insuperable problems to economic analysis of carbon transactions, if carbon pricing is based on social cost of raised CO<sub>2</sub> concentrations. However, it can be done in a two-stage way, using prices compiled for each date.

The DECC carbon price schedule may lead physically carbon-neutral forest cycles to have economic carbon deficits. They may cause destructive diseases to seem beneficial. In response to these bizarre cases, the question is: does variation in carbon prices which causes the results reflect the real impact of carbon fluxes on the world economy? If so, they should be accepted, as a date-dependent phenomenon. But if they reflect only the political expediency of meeting arbitrary targets, the further question has to be asked: are there good reasons why a tonne of CO<sub>2</sub> in the atmosphere should have a different value, irrespective of the time when (or the economic activity by which) it is fixed or volatilised? An answer of “yes” might be based on growth of the world economy and population. This indeed could justify apparently bizarre and paradoxical results (Price, 2012a). As for the proposed variation in discount rates, is that also soundly based? Or, as I have argued (Price, 2004, 2005) is it a matter of administrative convenience and political expediency?

If these irregularities do reflect real-world changes, we have to take them seriously, accepting the consequent difficulties of calculation, and the needed remaking of theoretical forest economics. If they are questionably based, we should ask: can we ignore government-mandated procedures, and continue in our cosy world of familiar axioms and helpful formulas? or do we use the instability of results in a challenge to the validity of the mandatory processes?

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# Perceptions of tree disease mitigation: what are people willing to pay for, and what do they actually get?

Colin Price<sup>1</sup>

<sup>1</sup> Colin Price Free-lance Academic Services, 90 Farrar Road, Bangor, Gwynedd LL57 2DU, UK, c.price@bangor.ac.uk

## Abstract

Some problems found in stated preference approaches to environmental valuation are particularly serious in valuing tree disease. Respondents seem to include regulating and supporting service values, which they are ill-qualified to do. Cultural service values for respondents are distorted by the questionnaire itself, making them invalid for the population over whom valuations are aggregated. The element of citizen valuation can be captured in contingent referenda, but this too tends to include inappropriate elements. More reliable benefit estimates are derivable from actual day-to-day purchase of cultural services, transferred to the context of tree disease.

**Keywords:** tree diseases, landscape, economic valuation

## Introduction

In recent years waves of tree diseases have surged across Europe, encouraged by international movement of plant material and by climate change. Some pathogenic organisms known for decades have mutated into more aggressive forms that threaten both commercial and environmental aspects of forestry.

Costing disease and valuing mitigating measures require assessment of impact on wooded landscapes, as perceived by the public. Such assessments have become part of the general discourse of environmental economics. Applications also exist to the visual effects on trees of insect attacks (Crocker, 1985) and disease (Mourato, 2010).

Over many years, strong criticisms have been made of contingent valuation and similar methods, as used for environmental issues. This has particularly been so when issues are emotive, provoking strong stakeholder reaction. The specifics of tree disease sharply focus many problems encountered in applying stated preference approaches. This paper revisits the problems, as I have presented them over 20 years, but in a tree disease context. It does not review problems of stated preference systematically, but concentrates on some major issues that have been neither widely recognised nor resolved.

## The set of included values

In the 1980s a major UK forestry controversy was afforestation of Scotland's Flow Country. A questionnaire on willingness to pay to *stop* this fundamental landscape change was designed to expose some problems with the approach. The results appear in table 1. As it happens, one principal species, lodgepole pine, is that most seriously affected by *Dothistroma pini*. One possible result of the disease would be to reverse the landscape effect of afforestation.

Table 1. Willingness to pay to prevent afforestation of the Flow Country

Components included in value	Aggregate value (£million)	Proportion of initial value
All ...	67 900	100%
less doubled-counted values ...	-7 500	-11%
less intrinsic values ...	-16 600	-24%
less regulating/supporting values	-20 500	-30%
Cultural service values ...	= 23 300	34%
for those with prior knowledge ...	3 062	4.5%
at pre-information level ...	1 724	2.5%
adjusted to geographical zones	307	0.5%

Source: modified from Price (1999a)

The total willingness to pay, about £68 billion, was then about 10% of the UK's GNP, which raises questions about what respondents were actually valuing. They were asked to allocate willingness to pay across several ecosystem services now widely recognised (Watson and Albon, 2011). Among these, double-counted values are treated later. Intrinsic values are experienced by members of the ecosystem themselves. They are the least-understood of values, and cannot, of their nature, be properly assessed by humans. Regulating services include ecosystem influences (Kittredge, 1948) that improve environmental conditions as through watercourse or atmospheric regulation. Supporting services, like nutrient recycling, underpin general ecosystem functioning. MacDonald (2010) suggested that, because they only support the other services, as supplied by other elements of the ecosystem, including supporting services may also double-count values. The validity of valuations of regulating services is addressed later. Only the cultural service values represent what should really be sought from the public, that is, their valuation of the visual impact of ecosystem change.

### Information bias

But the question is now raised, as to how many respondents were actually in a position to value any of these services, even the cultural ones. In particular, for a landscape rarely visited by the general public, how many would be affected by personal experience? At this time, much was made of "passive use values", accruing to those who would not visit physically, but who would be psychologically affected by *knowing* that a landscape was threatened by change, or that it had been preserved from change.

Such values, of course, cannot be experienced by people ignorant of a landscape's existence, or of any threats to it: they would, in practice, remain "blissfully unaware", whether change proceeded or not. To establish what the relevant population was, respondents were asked if they knew about the Flow Country. Some respondents do not wish to appear ignorant, or may explore false memories of a place that have been constructed by exposure to the questionnaire. An attempt was made to uncover such a bias, by asking what characteristics respondents associated with the Flow Country: it became evident that many were actually thinking of The Low Countries (Netherlands and Belgium). Adjusting for the majority who it seemed did *not* know the Flow Country further reduced the value legitimately attributable to the landscape preservation. Also, respondents who genuinely knew the Flow Country were concentrated in Scotland and to a lesser extent in the rest of the UK, with no-one from elsewhere knowing the place at all. Aggregating the values from the questionnaire only over the proportion of "aware" population within each origin led to further reduction in legitimate value.

A contention often made in contingent valuation's early days was that respondents needed information about species or habitats under threat, before their willingness to pay would be valid. This was given in my own questionnaire, with the rather typical result, that valuations

almost doubled after information had been imparted. But this “informed state” exists only among participants in the questionnaire: the pre-information values better represent the wider population, to whom valuations are aggregated. Nowadays a political point is also made, that the population “has a right to know”.

de Bruin et al. (2014) recently obtained survey evidence that information about tree disease really does affect people’s perceptions and priorities (and presumably, if asked, their willingness to pay). Such informing of the public may appear part of the democratic process. But imparting knowledge, particularly of a scientific kind:

- ❖ affirms in the respondent’s mind an “expert” role, which nonetheless is based on a thimbleful of knowledge, by contrast with ...
- ❖ ... real subject experts, who would probably, after a lifetime’s work on ecosystem services, acknowledge that they knew very little. Nonetheless these are the best people to judge the physical significance of regulating and supporting services. Questionnaires to the public can only reveal *perception* of regulating and supporting values, not the values actually delivered by a complex web of processes. Who, among respondents, actually knew the welfare significance of a tonne of CO<sub>2</sub> in the atmosphere? None!
- ❖ By presenting scientific facts, it legitimises focus on “non-cultural” valuation, whereas cultural values are actually the ones on which the respondents have legitimate expertise, based on their own intuitive perception – the values which in fact these investigations should reveal.
- ❖ It actually creates unhappiness in the minds of respondents, by notifying potential bad outcomes of which they might never have been aware. In a pilot survey of responses to a red squirrel conservation programme, negative feelings if the programme failed were: guilt for not supporting the programme [1 respondent]; sadness for the impoverished resource [12]; sadness for the squirrel [7]; anger at human apathy [4] (Price, 2001). Admittedly, there could have been no escaping the catastrophic landscape consequences of, say, Dutch elm disease in the UK. But is it possible that the effect of *Dothistroma* – which mostly slows growth in some crops, and kills others that are usually well out of the public view – might pass almost unnoticed, except if attention is drawn to it?
- ❖ Perhaps most seriously, the process of “informing” creates a respondent body which is a tiny subset of the relevant population, but is thereby made precisely unrepresentative of that population. And yet the subset’s distorted values will, in the normal course of stated preference valuations, be rolled out to the un-informed population (Price, 1999a).
- ❖ Even an “informed” population is likely over time to lose the focus created by the method of informing. Sensationalist newspaper information of the kind “Dieback disease will devastate England’s landscape!” creates this week’s environmental cause. Perhaps next week readers will have forgotten it, and the values it transiently constructed.
- ❖ If a right to be informed exists, information should be given on *all* environmental issues. Otherwise a questionnaire will focus concern ...

## **Symbols, apple-pie values and citizens**

Giving information about one particular issue, species or habitat “headlines” it as a conservation priority. An inkling of the importance of symbolic effects is given by an exploration of motivations for willingness to pay, as expressed through another pilot questionnaire (Price, 2001). In table 2, response II evades the question actually asked, which did *not* offer to maintain genetic resources intact: *Rafflesia* is being used as a peg on which to hang a general concern. Response III arises from distrust of the questioner’s integrity, yet evinces willingness to pay for something fictitious that nonetheless acts as an emblem of conservation. Response IV relies on a perception that the questioner is, by contrast, someone who knows what is important. Response V is reflexive, turning welfare back on the individual’s psyche, rather than on the importance of the conservation issue in question.

Table 2. Reasons for giving a passive use value for *Rafflesia arnoldii*

Reason for giving this value for the species	Number of responses
I I knew about the importance of this species	2
II I believe that genetic resources should be maintained intact	9
III I suspected that this species does not really exist	6
IV I thought you would not have asked these questions if it wasn't important	4
V I want to be seen as someone who is concerned about nature conservation	2
VI I didn't know anything about it	13

Concerns about such responses have motivated increasing use of follow-up questions such as: “How confident are you that your valuation is approximately correct?”; and “Is this valuation *actually* for this disease, or were you *really* giving your value for ALL diseases?” (cf. Hanley et al., 1998). While giving insight into the valuation process:

- ❖ Follow-up questions may seem to challenge the respondent’s integrity or competence, thereby provoking some hostility.
- ❖ Exploration gives an indication of how wrong the original answer might have been, but *not what the right answer is*.
- ❖ The originally given value may become an anchor-point, from which departures, if any, are made only conservatively.
- ❖ Headlining of an issue, and questioning motivations and perceptions, do change *real* perceptions ...
- ❖ ... but perhaps only temporarily, only while the questionnaire remains in near memory;
- ❖ ... and only for the respondents themselves, again. By informing a subset of the population, sensitising them to a particular issue, encouraging reflective thought, we make them precisely atypical of the population across which the extracted values are later aggregated.

Raising issues may also engage “apple-pie and parenthood” values – those values which “every right-thinking person subscribes to”, and (in the frequent experience of those applying questionnaires) on which they will put no willingness to pay. The quintessential response – “How can you possibly put a money value on a child’s life or health?” – evinces a belief in lexicographical values (Sagoff, 1988). The contention is that certain values – justice, beauty, and perhaps health – always take precedence over personal consumption values of the kind implied in willingness to pay questionnaires.

In practice, of course, society makes such trade-offs, through budgets for legal aid, national health services, art and landscape conservation. No unbiased person advocates that the entire national economic effort should be used to save one child’s life, not least because other lives would thereby be forfeited. Nonetheless, exploratory questioners may face descriptive responses such as “This place means the world to me! As it is, as it always was.” There *are* landscapes containing pine, perhaps threatened by Dothistroma, Scots pine especially, which may have personal significance. Ruskin’s words – “The first thing which I remember as an event in life was being taken by my nurse to the brow of Friar’s Crag on Derwentwater” – are engraved on a memorial stone below pine trees, and apparently on the hearts of many later observers who have felt a kinship to *this place*. But the persistent questioner might rejoin: “You say that, but would you really give up everything, to keep this view for yourself?” And there are two lines of replying to such follow-ups.

Take an infertile hillside in Scotland or Wales, planted with lodgepole pine, as was once customary, to a boundary unsympathetic to topography. If the question is: “What would you be willing to pay to achieve beautiful re-landscaping of this forest?” the lexicographical response might be “I will pay nothing – because I feel passionate about beauty!” But, should the question be: “What would you be willing to pay to prevent disease killing trees in this forest?” the response might be “I will pay nothing! I also feel passionate. But about tree health, not beauty.” Although such conflicting responses might be expected when deliberative democracy is used in place of economic valuation, there is no way of weighing what the importance of intransigent passion might be, when revealed only through the filters of culture and personality.

And so we return to what underlies responses to values articulated with non-negotiable ethical force. When the questioner asks “You say that, but would you really give up everything, to keep this view for yourself?”, the moral high-ground response might be “No, but I want other people to be able to enjoy it too.” The consumer is transformed into a public-spirited citizen.

In this context, contingent valuation questions have been recast as though within a political realm. “What would you be willing to pay for ...?” is transmuted into “Would you vote for a programme to control this tree disease effectively, if that required an increase of £ $X$  in taxation?” Varying the value of  $X$  in such a “contingent referendum” allows identification of the value at which the electorate would be split equally between paying and not paying the tax, at which point the benefit of disease prevention is taken to equal the tax. Typically, such formats elicit higher values, with fewer protest bids from those having lexicographic mind-sets (Ovaskainen and Kniivilä, 2005).

But, while eliciting an effective willingness to pay where other formats fail, the meaning and validity of the responses may be questioned (Price, 2006). What should the truly good citizen desire? Logically, it should be the best interest, the maximum welfare, of the aggregate of all citizens: “the greatest good to the greatest number ... for the longest time” (Pinchot, 1910). If, however, citizens are valuing on behalf of other citizens, how do they know those citizens’ own values? To the extent that their motives are genuinely altruistic, they merely double-count what other citizens *themselves* say of their own values (see table 1). By contrast, the warm glow felt for supporting communitarian benefits, rather than personal consumption, are a genuine addition to welfare. In the seditious words of Larcom (1931), a hymn-writer who worked as a factory supervisor in the world’s most capitalist country:

The grass is softer to my tread  
*because* it rests unnumbered feet;  
sweeter to me the wild rose red  
because she makes the whole world sweet.  
[my emphasis]

Yet such values might equally accrue to all things that contribute to welfare. I am willing to pay something extra for a National Health Service that gives everyone the same access to health care as I could provide for myself by private insurance. But I would also pay something for everyone to be able to provide food – purchased as private consumption – for themselves and family: hence purchase of fair trade goods. If a communitarian premium exists, it applies to a wide range of economic goods, and to apply it only to the target of our particular evaluation is to tilt the playing field in its favour.

To avoid such distortions, contingent questions should include contextual directives such as: “Please answer from your own point of view: we shall ask other citizens for their own views.” And “We shall also be valuing effects on timber production, CO<sub>2</sub> levels etc., as another study: you need not consider them.” Arguably, by so doing we elicit genuine individual cultural

values, less trammelled by apple-pie and parenthood thinking, and by a falsely perceived need to value on behalf of the community. Why, after all, would anyone really vote for anything except their own best interest – given that such interest includes the interpersonal utility gained by providing benefit to others? Do people actually vote in a less self-interested manner than the way in which they make consumption purchases – which these days includes and probably always included an element of ethical consideration? With such modification and interpretation, contingent referenda do offer a better way of determining willingness to pay than do contingent valuations. They can be constructed as choice experiments that somewhat reduce headlining and symbolic responses.

### **Subjectivity or benefit transfer?**

Symbolic responses will nonetheless remain. The problem arises because all such approaches necessarily focus on *issues* rather than *welfare*; on *change*, not *states*; on *processes*, not *outcomes* (Price, 1999b). Of course, change and process are important: the long-lasting response to loss of English elm from the UK landscape through Dutch elm disease still affects those who witnessed it, not just because of a no-longer-existing idiosyncratic presence, but because of the process whereby loss occurred, and perhaps because of its perceived genesis in human negligence.

They *used to* stand alone, aloof, in sombre lustres,  
Englishly ungaudy in their lofty looks;  
parasol to languid sheep and cattle clusters,  
high-rise home for flocks of disputatious rooks;  
[my emphasis]

“*Used to ...*”. Not just the loss or the causes of loss, but the poignant comparison with a former state. But process can take too-important a role. Respondents to questionnaires are thereby encouraged to adopt this focus: “*I’m being consulted by the government about this process!*” is a mental state fixed upon what is presently occurring, rather than how others – future others – not consulted will feel about the outcome. The UK government’s own dispensation on discounting is but a pale facsimile of the oft-demonstrated tendency of individuals to discount hugely over a short period, as between decision and outcome. Shackle (1958) characterises the overwhelming importance of the moment in which decisions are taken thus. “There is for us a moment in being, which is the locus of every actual sense-experience, every thought, feeling, *decision* and action.” [my emphasis]. And so the values engaged and created through the process of consulting with decision constructors (who include respondents) take undue importance, compared with values experienced by the outcome bearers. It is the latter group with which cost–benefit analysis should largely be concerned.

Once again, decision constructors have values which should not be transposed to the outcome bearers. Repeated evaluations have demonstrated the effect of minority knowledge on scores ascribed to a view in North Wales, in which a castle features. The castle is first perceived as medieval (to which those who had known Welsh history might respond adversely), which elicits a positive response for its grandeur and picturesqueness. Once it is known that it dates from a later period, partly financed by profits of the slave trade, values change markedly. Final, informed values of “what is”, are conditioned by the process of “coming to be” (which few of the population, however, know about) and the by process of evaluation (which few, however, are involved in).

How can utilities be projected, without engaging the distorting results of process? The answer is, by getting as close as possible to day-to-day decisions on landscape value, divorced from a particular issue. Figure 1 shows cost of travel to five Welsh landscapes, manipulated by the once-popular travel cost method to give cash values (Bergin and Price, 1994). Landscape

quality was judged subjectively on a scale similar to that of Fines (1968), which had been in use, providing consistent results, over a period of 20 years (Price, 2012a).

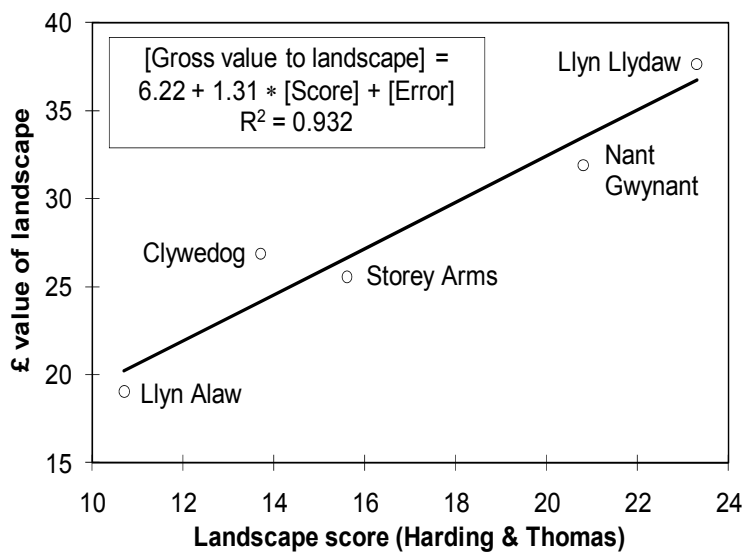


Figure 1. Revealed willingness to pay for landscape quality

Parallel but independent research by Henry (1998) has related expert judgement of landscape quality to house price.

Such monetary values for intervals of landscape quality could be transposed to the projected visual effect of tree disease. This is a process I have been advocating for 40 years (Price, 1976). Nowadays a similar process of transposition is advocated under the title “benefits transfer”. Perhaps if my paper had been titled, not “Subjectivity and objectivity in landscape evaluation”, but “Benefits transfer for cultural ecosystem services”, it might have been taken more seriously, and would now be a standard reference?

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# Governing Illegal Logging and the Comparative Advantage of Forest Product International Trade

Zhi-jie Guan<sup>1</sup>, Peichen Gong<sup>2</sup>, Jian-hua Cao<sup>3</sup>

<sup>1</sup>School of Business, Changzhou University, Changzhou, 213164, P. R. China, email:zhijie.guan@163.com

<sup>2</sup>Department of Forest Economics, Swedish University of Agricultural Sciences, Umea, 901 83, Sweden, email: Peichen.Gong@slu.se

<sup>3</sup>Institute of Finance and Economics Research, Shanghai University of Finance and Economics, Shanghai, 200433, P. R. China, email: caojianhua@mail.shufe.edu.cn

## Abstract

Illegal logging has become a global issue because of its effects on biodiversity and climate change. In order to reduce illegal logging, many countries around the world have introduced regulations of international trade of forest products. This paper examines the effects of efforts aimed at reducing illegal logging on the comparative advantage of seven types of forest products by using the HOV model. The results show that measures against illegal logging have affected the comparative advantage of international trade in different directions. The number of regulations a country enforced to combat illegal logging has negative effects on its net export of charcoal and wood residues, but has positive effects on the net export of other forest products. The effects are statistically significant for all types of forest products except paper and wood pulp.

**Key words:** illegal logging; international trade; forest products; comparative advantage

## Introduction

Illegal harvesting has existed for a long time. It has influenced forest ecological environment and the forest carbon storage significantly. Illegal logging is perceived to pose significant obstacles to the achievement of sustainable management of forests. It leads to the destruction of forest resources, biodiversity and other environmental services associated with forests (Kishor and Damania 2006; Tacconi 2007). In addition, and equally importantly, it gives rise to or supports other undesirable outcomes, such as networks of corruption, generating significant volumes of “black” money and crime (Smith et al. 2003; Tacconi 2007). In addition to this, illegal harvesting has reduced national financial revenues drastically.

Although illegal logging occurs mainly in some developing countries, it has become a global issue because of the increasing worldwide concerns about biodiversity and climate change. Many countries around the world have made serious efforts in attempt to reduce illegal logging. The Group of Eight (G8 countries) proposed an Action Program on Forests in 1998. Thereafter, USA, European Union and some other countries adopted a series of rules, laws and regulations to combat illegal logging. The UK first proposed the green procurement movement, EU has put forward the Forest Law Enforcement, Governance and Trade (FLEGT) action plan to reduce illegal logging through carrying out the VIP voluntary partnership agreement plan with some timber production countries, and EU started to implement new Wood Regulations across European Union to combat illegal logging in 2013. USA implemented Lacey Act Amendment in 2008, where a clear definition of illegal timber is provided. According to FAO forest resource assessment report (FAO, 2010), some conventions like Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora

(CITES), and the International Tropical Timber Organization (ITTO) process, also have helped in preventing illegal logging.

Efforts to combat illegal logging have shown many effects. Bosello et al. (2013) used an Intertemporal Computable Equilibrium System to evaluate demand and import condition after implementing illegal logging ban in global timber market. Their result shows that EU ban eliminates illegal timber from the market, but it forms illegally produced secondary products accompanying exported products in some illegal logging countries or states, which reduces the role of the EU ban. Li et al. (2008) suggested that, although illegal timber will be substituted to some extent by legal wood, the global timber supply will decrease and its world price will rise, which increases the cost of processed wood products. All these create effects on production, processing and consumption countries at different level. Putz et al. (2008) analyzed the opportunities and challenges of reducing harvesting. But until now the effects on the comparative advantage of forest products in international trade have not been investigated.

Some scholars have applied HOV model in studying forest products trade. Liu and Tian (2007) tested the applicability of HOV model to analyze international trade of forest products using data of 54 countries in 1995, 1998, 2001 and 2004. They concluded that international trade flows of total forest products, logs, other wood, sawnwood, wood-based panel, wood pulp and recycled paper are in line with the trade theory of comparative advantage. They also added environmental variables to test their effects on forest products trade flow. Although their result shows that the environmental variables did not have any significant effect, the conclusion does not rule out the impact of a government's environmental policy on forest products trade flow. Uusivuori and Tervo (2002), using 18 OECD countries for the period 1977–1998, analyzed how forest endowment and economic activity affected net trade of industrial roundwood and forest products. They found limited support for the Heckscher–Ohlin model and concluded that while historical differences in forest industries and resources still exist, the role of forest resources is becoming less important in shaping the development of forest industries. However, they fail to include the increasingly more important energy sector where forest resources are used as fuel. Bonnefoi and Buongiorno (1990) empirically tested the model and concluded that for all examined commodities (roundwood, sawnwood, panels, pulp and paper) forest endowment has a positive effect on net trade. Furthermore, they found that domestic demand, measured by income, has a negative effect on net trade. Both results are coherent with theoretical predictions.

The aim of this paper is to examine the impact of regulations against illegal logging on trade flow within the traditional comparative advantage theory, based on HOV model. In order to do this we extend the traditional HOV model by introducing an environmental variable related to the efforts of combating illegal logging and study how it affects trade comparative advantage. The paper extends Liu and Tian's (2007) analysis in number of ways. 1. The selection of forest products follows strictly the definition of FAO. Furniture is also considered because of the close relationship between the export of furniture and illegal logging; 2. The samples are expanded to 91 countries, and their trade amount represents about 95% of world imports and exports. 3. The time period of the analysis is extended to 2005 - 2011; 4. The number of regulations aimed at combating illegal logging and per capita income are included as explanatory variables. Per capita income influences the market demand for forest products. It also reflects people's environmental attention due to the strong correlation between per capita income and environmental attention (Dasgupta et al., 2001).

The remainder of the paper is organized as follows: Section 2 introduces the research methods and data. Section 3 presents the model estimation result. Section 4 concludes.

## Research methods and data

In general, the magnitude and direction of forest product trade flows are determined by geography, size of economies, character of forest endowments and government policies. Classical trade theory prescribes that trade occurs because there are differences among trading partners in their relative costs of production. The link between net trade, prices and resource endowments is provided by the Heckscher–Ohlin model (Heckscher, 1919; Ohlin, 1933), which has had mixed success in empirical analyses. The Heckscher–Ohlin model predicts that a country's net exports of a given good are a positive function of its resource endowments and a negative function of its income. There are a number of assumptions underlying the Heckscher–Ohlin model (Prestemon and Buongiorno, 1997): (i) there exists factors that are immobile between countries; (ii) markets are competitive, with no barriers to trade; (iii) the same technology is universally available and; and (iv) consumption is homothetic with respect to income.

In this paper we use econometrics method to examine the effects of resource endowments on the comparative advantage of forest products international trade. Following Tobey (1990), who suggested the basic idea, we add an environmental variable in the model to examine its effect on 7 types of products: roundwood, sawnwood, other wood, wood-based panels, wood pulp and recycled paper, paper and paperboard, furniture, and their sum. The dependent variable is net export value of the respective forest product, whereas independent variables include a country's capital stock, three types of labor force according to education level, forestland area, per capita income, and the number of regulations adopted to combat illegal logging. The model is expressed as follows:

$$NET_{ik}=C_k+\beta_0LAB_{1i}+\beta_1LAB_{2i}+\beta_2LAB_{3i}+\beta_3LAND_i+\beta_4KS_i+\beta_5EN_i+\beta_6PCI_i+\varepsilon_{ik}$$

where  $NET_{ik}$  means net export value of country  $i$  and product  $k$ ;  $C_k$  is a constant for product  $k$ ;  $KS_i$  is capital stock of country  $i$ ;  $LAB_{1i}$ ,  $LAB_{2i}$ ,  $LAB_{3i}$  refer to workforce with high, medium, and low quality respectively,  $LAND_i$  represents forestland area of country  $i$ ;  $EN_i$  is the number of regulations adopted by county  $i$  to combat illegal logging,  $PCI_i$  means per capita income,  $\varepsilon_{ik}$  represents the random error term.

Our classification of forest products differs from that in Liu and Tian (2007). In addition to the traditional products defined by FAO, we also examined the trade of furniture (including office furniture, kitchen furniture, bedroom furniture, and other wood furniture) Therefore, in the paper the effects of efforts to reduce illegal logging on the trade of roundwood, other wood (charcoal, wood, scrap and residues), sawnwood, wood-based panels, wood pulp and recycled paper (hereafter referred to as wood pulp), paper and paperboard (hereafter referred to as paper), furniture, as well as the sum of all these forest products are studied.

Forest products data come from International Trade Centre Trade Statistics. Forestland area, per capita income and capital stock data come from World Bank (WDI). High quality workforce means high education and technic worker (data come from WDI), low quality means illiterate (data comes from UNESCO), and medium quality is the remaining part of the total economic population. Efforts in combating illegal logging are represented by the environmental variable  $EN$ , which is measured by the number of relevant regulations enforced by each country. Combining the report of Brack and Hayman (2001) and FAO forest resources assessment report (FAO, 2010), we identified 3 environment regulations: CBD, ITTO, CITES, which all contribute to reducing illegal logging. Each country's domestic laws and regulations aimed at combating illegal logging, like green procurement policy, America Lacey Act Amendment and European wood regulations, are also recognized. Moreover, according to the illegal logging port website, the EU Member of FLEGT (Forest Law Enforcement, Governance and Trade) action

plan as well as voluntary partnership agreements (VIP) with the European Union's member countries are also regarded as combating illegal logging regulations. Descriptive statistics of the data are presented in Table 1.

Table 1. Descriptive statistics of the data

Variable implication	Variable	Mean	Maximum	Minium	standard deviation
High quality labor force (thousand)	LAB <sub>1</sub>	20,600.11	534,090	11.79	59,832.33
Middle quality labor force (thousand)	LAB <sub>2</sub>	13,078.75	759,788.2	10.67	52,805.97
Low quality labor force (thousand)	LAB <sub>3</sub>	6,604.79	287,355.5	0	31,361.78
forestland area (square kilometer)	LAND	350,424.30	8,091,500	23	1,102,780
Capital stock (billion USD)	KS	73,253.58	1,860,000	66,687.73	214,000
Illegal logging regulations	EN	2.68	5	0	1.13
Per capita income (USD)	PCI	15,020.42	99,697.76	146.07	18,446.17
Net export of roundwood (thousand USD)	ROUND	-48,376.14	4,136,007	-8,267,412	713,788
Net export of sawnwood (thousand USD)	SAWN	-1,413.84	8,183,556	-704,502	1,070,136
Charcoal, wood, scrap and residues net export (thousand USD)	OTHER	-51,418.4	956,749	-3,038,581	331,399.4
Wood-based panels net export (thousand USD)	PANEL	35,941.86	5,637,603	-5,743,315	755,686.1
Wood pulp and recycled paper net export (thousand USD)	WOODPULP	-106,461.8	7,236,411	-18,676,452	1,654,300
Paper and paperboard net export (thousand USD)	PAPER	46,407.57	10,477,538	-5,835,378	1,772,898
Furniture net export (thousand USD)	FURNITURE	21,352.34	10,915,734	-11,411,831	1,448,686
Total forest products net export (thousand USD)	TOTAL	-103,968.4	25,804,489	-27,048,409	4,139,098

## Result and discussion

Before estimating the model, we examined the correlations between different variables. The correlation matrix between the variables is presented in Table 2. The dotted lines form three regions. The first region shows the correlation coefficients among the independent variables. The second region shows the correlation coefficient between dependent and independent variables, indicating the influence of resource endowments on the value of forest products net exports. The third region shows the relationship among the dependent variables, indicating how and to what extent the net export of one product will affect the next export of another product. Based on the results in Table 2, we can draw the following conclusions.

1. There are significant correlations between the independent variables. High interdependency among independent variables may create multiple collinearity, which influence the real result of the model. Examination of the VIF value reveals that the model can be estimated without paying attention to multicollinearity (the VIF values for LAB<sub>1</sub>, LAB<sub>2</sub>, LAB<sub>3</sub>, LAND, KS, EN and PCI are 6.3, 3, 2, 1.2, 2.5, 1.8, 2 respectively, all lower than the critical value of 10).

2. Factor endowments have different effects on net exports of forest products. The result suggests that rich human resource is still a main driver of the net export of processed products like furniture, paper and paperboard in some developing countries, which caters to the countries development character. Also the result shows that larger forestland area in a country will

increase its net export of raw material products, and reduce the net export of processed forest products. Furthermore, the result also suggests that the abundance of capital in a country will reduce its net export of all types of forest products.

3. Negative or positive correlations have been found between net exports of different types of forest products. A negative correlation between two products means that the products are substitutes, such as roundwood and paper, roundwood and furniture, wood pulp and furniture. A positive correlation exposes that the products are complementary, such as sawnwood and all other kinds of forest products.

Table 2. Correlation matrix of the variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.LAB <sub>1</sub>	1														
2.LAB <sub>2</sub>	.786**	1													
3.LAB <sub>3</sub>	.622**	.562**	1												
4.LAND	.356**	.225**	.079*	1											
5.KS	.616**	.311**	.106**	.358**	1										
6.EN	.122**	0.037	-0.003	0.016	.272**	1									
7.PCI	-0.005	-.120**	-.150**	0.045	.305**	.656**	1								
8.ROUND	-.591**	-.685**	-.339**	.242**	-.147**	-0.071	0.016	1							
9.SAWN	-.305**	-.208**	-0.056	.251**	-.456**	-0.04	-0.013	.302**	1						
10.OTHER	-.136**	-.085*	-0.002	-0.016	-.243**	-.143**	-.108**	.307**	.247**	1					
11.PANEL	.282**	.445**	.118**	.130**	-.236**	0	-.150**	-.381**	.429**	.214**	1				
12.WOODPULP	-.516**	-.597**	-.202**	.203**	-.084*	0.014	.149**	.708**	.455**	.126**	-.380**	1			
13.PAPER	-.092*	-0.057	-0.077	0.057	-.112**	.128**	.217**	-.095*	.643**	-0.042	.346**	.197**	1		
14.FURNITURE	.220**	.463**	.141**	-.092*	-.396**	-0.043	-.237**	-.586**	.184**	-0.039	.730**	-.602**	.177**	1	
15.TOTAL	-.309**	-.198**	-.116**	.203**	-.426**	0.012	0.033	.242**	.930**	.255**	.497**	.454**	.779**	.262**	1

\*\* significant at 1% (2-tailed). \* significant at 5% (2-tailed).

In this paper, we use the least squares method to estimate the model. With consideration of the possible presence of heteroscedasticity in the cross-section variables, we use White test to check and correct through Heteroscedasticity Consistent Coefficient Covariance in regression process. In order to analyze the influence of regulations related to illegal logging, we first estimated the model without including the EN variable. Thereafter, we included the EN variable and reestimated model. The results are presented in Tables 3 and 4.

Table 3. Regression result without EN variable

Variable	C	LAB <sub>1</sub>	LAB <sub>2</sub>	LAB <sub>3</sub>	LAND	KS	PCI	Adjusted R-squared
FURNITURE	84062.03*** (3.771)	19.628*** (5.705)	11.532*** (5.345)	-22.36*** (-7.71)	-0.129*** (-3.448)	-6.435*** (-9.814)	3.092 (1.521)	0.68
OTHER	20948.43 ** (-2.098)	0.134 (0.196)	-0.417 (-0.87)	0.384 (0.916)	0.025 (1.32)	-0.402 (-1.553)	-0.63 (-1.103)	0.06
PAPER	-286551.8*** (-6.396)	1.572 (0.521)	1.078 (0.386)	-3.595** (-2.211)	0.198** (2.519)	-2.328*** (-3.37)	28.048*** (4.161)	0.09
SAWN	-47125.09** (-2.131)	-2.214** (-1.988)	-1.79*** (-3.65)	3.973*** (4.141)	0.497*** (7.586)	-2.97*** (-4.947)	8.793*** (3.095)	0.44
WOODPULP	-106109.4*** (-2.83)	-26.849*** (-8.004)	-10.821*** (-11.988)	27.699*** (8.07)	0.663*** (7.206)	3.049*** (5.387)	3.706 (1.526)	0.66
ROUND	56563.05*** (5.779)	-9.555*** (-5.819)	-6.267*** (-6.767)	7.522*** (5.155)	0.323*** (6.809)	1.036*** (4.162)	-4.32*** (-5.764)	0.75
PANEL	-11838.26*** (-0.713)	9.948*** (5.865)	4.754*** (3.703)	-11.257*** (-8.813)	0.074** (2.424)	-2.948*** (-6.969)	3** (2.292)	0.51
TOTAL	-341947.7 (-3.563)	-7.33*** (-1.272)	-1.93 (-0.387)	2.37 (0.739)	1.64*** (6.087)	-11*** (-4.638)	41.69** (3.502)	0.37

\*Significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%, t value in parentheses.

Looking at the effect of resource endowments in the models, we can see that the labor factor has exposed a significant effect on the net export of all kinds of products except paper, other wood and the total net export of all forest products. However, low quality labor has a significant effect on paper and high quality labor has a significant effect on total forest product. Capital stock as well as forestland area has significant effects on the net exports of all kinds of products with the exception of other wood. Per capita income has significant effects on net exports of paper, roundwood, wood-based panels, sawnwood and the sum of all forest products.

Table 4. Regression result with EN variable

Variable	C	LAB <sub>1</sub>	LAB <sub>2</sub>	LAB <sub>3</sub>	LAND	KS	PCI	EN	Adjusted R-squared
FURNITURE	-274927*** (-3.701)	19.354*** (5.584)	11.362*** (5.27)	-22.501*** (-7.681)	-0.117*** (-3.136)	-6.46*** (-10.191)	-4.05** (-2.531)	176127.2*** (4.521)	0.69
OTHER	34335** (2.242)	0.176 (0.257)	-0.391 (-0.813)	0.405 (0.957)	0.023 (1.225)	-0.398 (-1.549)	0.470 (0.621)	-27123*** (-2.798)	0.06
PAPER	-318366** (-2.364)	1.556 (0.514)	1.067 (0.383)	-3.604** (-2.208)	0.199** (2.525)	-2.33*** (-3.371)	27.614*** (4.061)	10702 (0.162)	0.09
SAWN-WOOD	-162425** (-2.405)	-2.302** (-2.073)	-1.849*** (-3.858)	3.927*** (4.076)	0.5*** (7.606)	-2.98*** (-4.965)	6.499** (2.519)	56568.58* (1.838)	0.44
WOOD PULP	-134326.1* (-1.785)	-26.87*** (-7.968)	-10.834*** (-12.031)	27.688*** (8.08)	0.664*** (7.193)	3.05*** (5.373)	3.145 (1.396)	13843.67 (0.426)	0.66
ROUND-WOOD	-2326.869 (-0.12)	-9.6*** (-5.842)	-6.295*** (-6.794)	7.498*** (5.165)	0.325*** (6.844)	1.03*** (4.102)	-5.491*** (-6.348)	28892.6*** (2.68)	0.75
PANEL	-179278*** (-3.697)	9.82*** (5.748)	4.675*** (3.648)	-11.323*** (-8.769)	0.079*** (2.608)	-2.96*** (-7.052)	-0.327 (-0.271)	82149*** (3.314)	0.52
TOTAL	-1037314 (-3.638)	-7.867*** (-1.362)	-2.265 (-0.455)	2.091 (0.645)	1.673*** (7.083)	-11.05*** (-4.673)	27.86** (2.496)	341161 ** (2.533)	0.37

\*Significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%, t value in parentheses

Regarding the effect of the environmental variable, firstly we notice that the R-squared values of the models remain unchanged after adding the environmental variable, meaning that the variable does not change the explanatory power of the models. Secondly, we find that the environmental variable have significant effects on the net export of all types of forest products except wood pulp and paper. The effect is significantly positive on the net exports of furniture,

roundwood, wood-made panels, sawnwood, and the total net export of all products, and significantly negative on the net export of other wood.

It should be noted that the R-squared value of the models for other wood and paper is very low, implying that the models are inadequate for explaining the net export of these two types of forest products.

## Conclusions

In this paper, 91 countries' data from 2005 to 2011 are used to test the impact of regulations against illegal logging on the comparative advantage of international trade of different categories of forest products based on the HOV model. The main conclusions are as follows:

1. Different factor endowments have different effects on the net export of forest products. Capital stock affects all kinds of forest products including their sum significantly. It affects the net export of roundwood and wood pulp positively, but affects the other kinds of products negatively. It means that a larger capital stock is advantageous for the net export of forest products of raw materials, but is disadvantageous for net the export of processed forest products. Forestland area has significant effects on the net export of all types of forest products except other wood, and its effects are positive for all kinds of forest products except furniture. Naturally we can derive that forestland area is still an important determinant of the comparative advantage of the forest products international trade. The effect of high and medium quality labors on the comparative advantage is negative for primary forest products like roundwood and sawnwood, but positive for processed forest products like furniture and wood-based panel. Low quality workforce has brought the opposite effects, its effects for the processed forest products are negative, while the effect for primary forest products are positive.

2. In the models that do not include trade regulations as an explanatory variable, per capita income affects all types of forest products' export positively except roundwood and other wood. This result is inconsistent with the theory of international trade. Although the effect of income on the net export of roundwood and other wood is negative, these two types of products are not consumption goods for which the demand would automatically increase when income increases. The result seems suggest that income has structural effects on the forest sector such that richer countries have better developed wood processing industry. This would explain the observed effects of income on the net export of different types of forest products.

3. Introducing trade regulations into the HOV model does not change the overall explanatory power of the model. The estimated model for other wood and paper has very low R-squared value. For some products like furniture, other wood and wood-based panel, in the new model PCI has exposed the opposite effect compare with the former one, as well PCI affects the net export of furniture significantly, while affects the net export of wood-based panel insignificantly.

4. Trade regulation aimed at reducing illegal logging have significant effects on the net export of different types of products except paper and wood pulp. The effect is positive on all kinds of forest products except for other wood. The result shows that the efforts against illegal logging have promoted the net export of major forest products, and their effects on the comparative advantage are mostly positive..



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# Optimal rotation with differently-discounted benefit streams

Colin Price

90 Farrar Road, Bangor, Gwynedd LL57 2DU, United Kingdom

## Abstract

The case is often now made that discount rates should decline with time. Underlying reasons include that some kinds benefit (or cost) might be discounted at a lower rate than that used for others: in particular, that rates for carbon values and environmental amenities might be less than that for timber. A lengthening sequence of rotations then arises, whether the benefits are consumptive ones realised at the rotation end, or non-consumptive ones whose annual value increases through the rotation. A timber discount rate lower than that for non-consumptive benefits leads to a shortening sequence of rotations. The results differ importantly from those of discounting at a reducing rate through time.

**Keywords:** differential discount rates, optimal rotation

## Introduction

At the meeting of the Scandinavian Society of Forest Economics in Lom (Price, 2008), I presented a tentative model of how an optimal sequence of lengthening rotations could be calculated, for circumstances in which the discount rate declined through time. The solution protocol was rather unstable, and a more successful model was produced for the Faustmann III symposium (Price, 2011). Both papers explored reasons put forward for declining discount rates, and reviewed some criticisms of those arguments; there is a fuller critique in Price (2004).

A more convincing – though still contested – case can be made for applying different discount rates to different kinds of benefit (or cost). This too causes rotation length to change through time, since the benefits to which the lower discount rate is applied will have greater influence as later rotations unfold.

## Differentiated discount rates

As an alternative to the popular illusion that *passage of time itself* is the mediator of declining rates, one could simply analyse segregated streams of benefit and cost, using differentiated discount rates – a main factor which gives rise to an apparent decline through time of overall discount rates. The focus being thus moved to the *causes* of different rates rather than the *effects*, there is less potential to draw spurious conclusions or to respond inappropriately to changing circumstances.

It has long been argued that benefits arising from the *presence* of a forest, and *increasing through with crop age*, would lengthen rotations (Hiley, 1956). Benefits in this category include landscape and recreation values, habitat for (some kinds of) flora and fauna, storage of carbon, and generation of non-timber forest products. Formal introduction of the effect into economic models of rotation is usually attributed to Hartman (1976). Those who have discussed this further include Strang (1976), Calish, Fight and Teegarden (1978), Johansson and Löfgren (1985), and Price (1987). Krutilla and Fisher (1972) and Fisher and Krutilla (1972) have argued for the increasing importance of such values in natural resource economics generally. But the *combination* of these

two effects – increasing importance of non-consumptive values, and their effect on rotation – seems to have been treated little if at all.

## The model

The following demonstration of the rotational effect of differential discount rates is based on a model with the following reasonable characteristics.

- Timber has no net sale value until a given age – 20 years in this case.
- Thereafter revenue per hectare rises rapidly at first, then at a decreasing rate.
- No thinning revenues nor time-profiled costs are included. They would not be expected to change the overall shape of results presented below.
- The discounted sum of annual management costs is invariant with rotation, so does not affect optimal rotation length.
- First formation cost is common to all rotations so has no influence, and the final revenue is treated as being net of regeneration costs.
- Discount rates used range down from 3.5%, the rate advocated by the UK Treasury for 0-30 years, down to 1%, advocated for beyond 300 years.

The solution algorithm is slightly modified from that used for declining discount rates.

- Initially, rotations are set arbitrarily long (200 years).
- Starting from the first year of the first rotation, the effect on NPV is tested of shortening the current rotation and bringing forwards all subsequent ones. This continues through the rotation until an age is reached at which shortening the rotation would decrease NPV: this is the provisional optimal rotation.
- The process is repeated, with the second rotation being provisionally optimised in the same manner. Increasing, as this does, the NPV of the second rotation, it may now be advantageous further to shorten the first rotation, in order to bring forwards this increased value.
- Now the third rotation is provisionally optimised, and so on, until no further shortening of any individual rotation improves the NPV of the entire sequence of rotations.

The solution appears at first to evolve chaotically, as shortening of earlier rotations makes space to add extra rotations within the time horizon, and as change in rotations between iterations leaves missing values. But, as the earlier rotations begin to stabilise, the final pattern emerges slowly but persistently, until a stable solution is reached.

## Results with two different terminal benefits

In this version of the problem, both kinds of benefit arise only at the end of the rotation. Timber is one obvious benefit of this kind: others are not so easy to conceive, but an “instant” carbon value arises if timber is used to displace high-embodied-carbon structural materials. The discount rate for timber (50% of the initially expected value) is 3.5% but that for the other benefit is only 1% – a figure adopted to display the limitations of the model. The expected result is that, as rotations succeed one another, the benefit with a low discount rate will dominate the result more and more, with rotation lengthening. Figure 1 shows this effect.

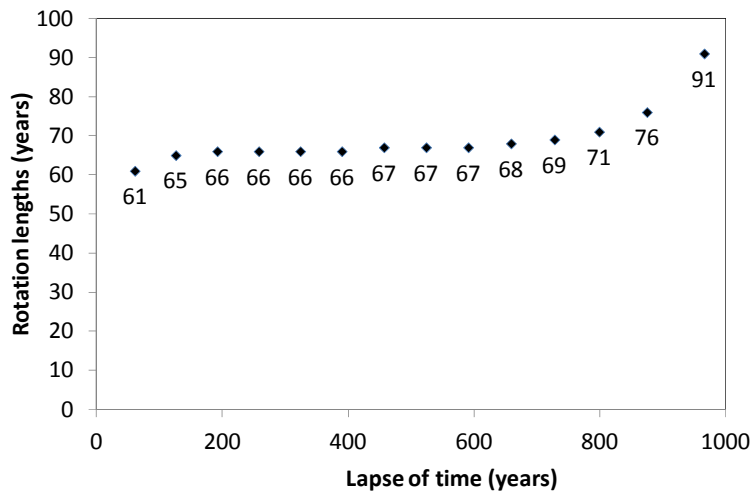


Figure 1. Lengthening rotation with two terminal benefits

An unexpected feature is that, instead of becoming asymptotic to what the optimal rotation would be if *all* benefits were discounted at 1% (66 years) the rotation eventually begins to lengthen more rapidly. This is an artefact, only significant at very low discount rates, of the limited 1000-year horizon of the simulation: as this horizon is approached, successor rotations have less and less opportunity cost, so there is increasing advantage in prolonging the rotation. A warning should be taken: clearly – and especially if some elements of benefit are discounted at a low rate – arbitrary time horizons can exert their effect long before the current rotation's NPV can be directly affected by it.

### Continuous benefit

More commonly discussed than the case of two terminal benefits, is the situation in which an annual, non-consumptive benefit arises through the rotation, typically growing as the size of trees and age of stand increase. In the model used here, the *annual* benefit is taken to be proportional to what the timber growing stock's sale value would be if felled at this age. This yields the dashed line in figure 2 as the cumulative value of (undiscounted) non-consumptive benefits through the rotation. The annual value of such benefits is set at 2% of whatever the value the timber growing stock has at any time. Notice the difference between the profiles, suggesting that even without differential discounting the non-consumptive benefits could exert a considerable lengthening of rotation.

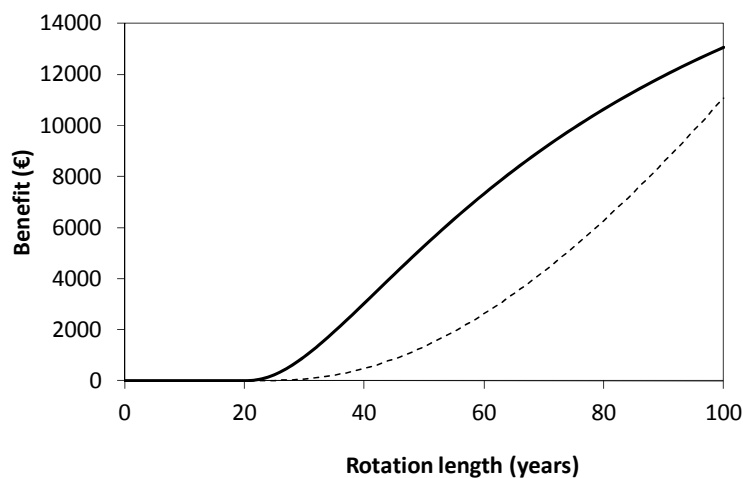


Figure 2. The values of timber and non-consumptive benefit

Considering only the benefit of timber, discounted at 3.5%, the optimal rotation would be 50 years: as expected, constant through time – the Faustmann rotation.

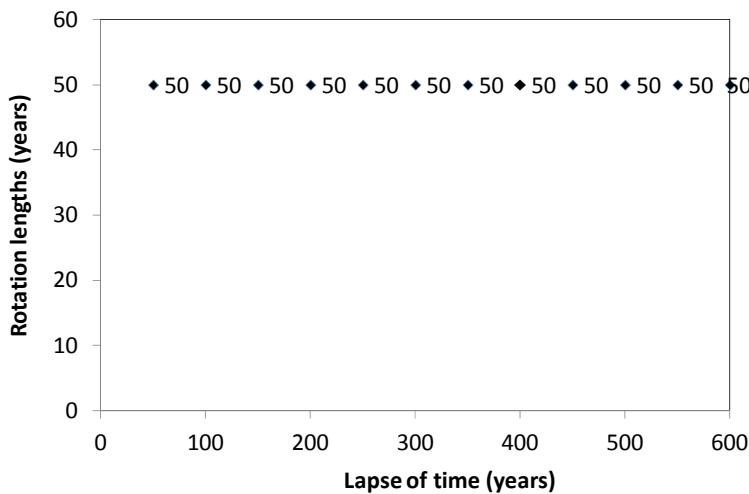


Figure 3. The result with a single discount rate, for timber only

With non-consumptive benefit initially at 1% of timber growing stock value, timber discounted at 3.5%, non-consumptive benefit discounted at 3%, and initial rotation set at 200 years, the optimal sequence of rotations is as shown in figure 4.

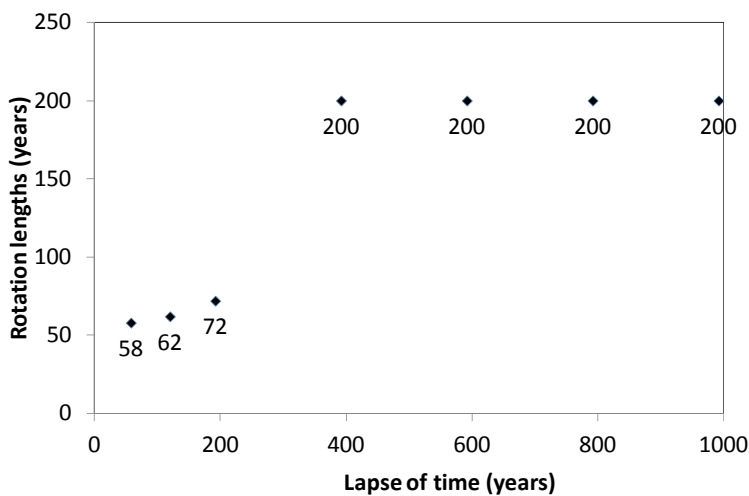


Figure 4. Lengthening rotation with timber and non-consumptive values

Note that, even with the small differential in the discount rates, eventually the optimum increases rather dramatically to the longest rotation allowed: the longer the rotation, the more influential becomes the next addition to the annual flow of non-consumptive benefits.

If the discount rate for non-consumptive benefit is 2%, or if annual non-consumptive benefit is initially as high as 2% of growing stock value, there is no transition of rotation: the optimum from the outset is, in effect, the growth span of the tree or even longer. (As the selected revenue function increases monotonically through time, this speculation cannot be checked.)

There are also forest influences which are increasingly negative through the rotation, and may grow increasingly important through time, for example losses of water for hydroelectricity generation (Barrow et al., 1986; Price, 1999). Their effect too can be modelled, with the

expected result: rotations shorten progressively. Figure 5 is based on an initial annual cost 0.5% of growing stock value, discounted at 3%, as against the 3.5% timber discount rate. If conditions prevail into the distant future, the optimal rotation eventually converges on the longest one that has no adverse effect, 20 years in this case.

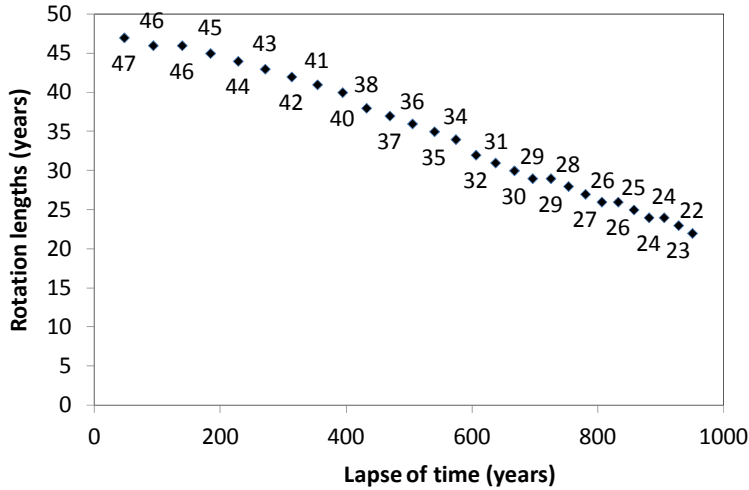


Figure 5. Shortening rotation with lower discount rate for annual costs

One could also envisage increasing timber shortage relative to provision of the public goods of non-consumptive environmental effects. Discounting timber revenues at 2.5% and water losses at 3%, the optimal rotation lengthens from 52 to 54 years (which is the optimal timber rotation at 2.5%).

With annual non-consumptive benefit initially at 1% of growing stock value, timber discounted at 3%, and non-consumptive benefit at 3.5%, the rotation shortens to 52 years, which is what the optimum would be, if there were no annual benefits.

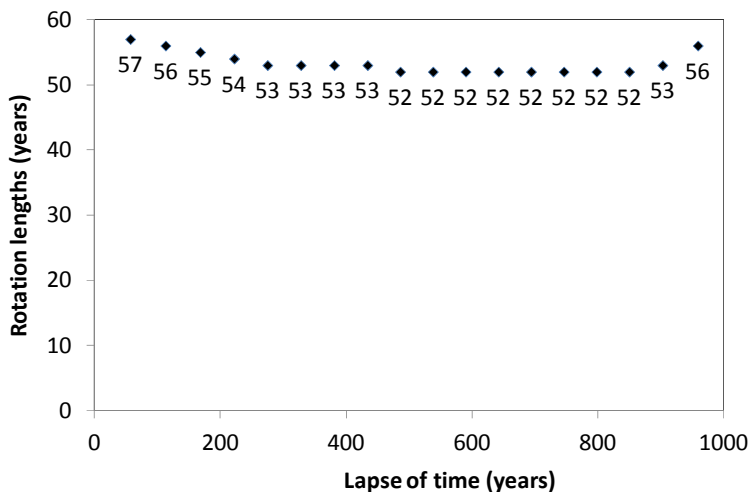


Figure 6. Timber discounted at a lower rate than non-consumptive values

And if annual non-consumptive benefits are initially 10% of timber benefits, the decline is more dramatic, essentially to the same asymptote.

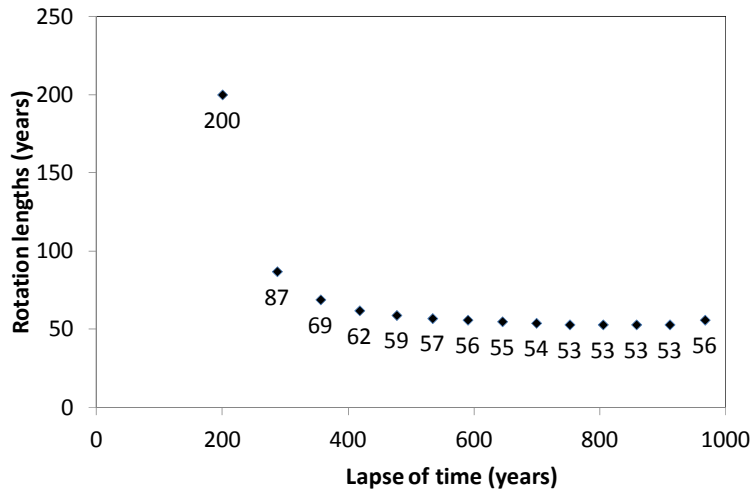


Figure 7. Timber discounted at a lower rate than initially high non-consumptive values

## Conclusions

So, are there any important conclusions, except the obvious one: that a low discount rate for one element of crop value will tend to change rotation lengths progressively? Perhaps so.

- The effect is *not* the same as that of a discount rate declining through time, which should therefore not be used as a surrogate for discount rates differentiated by class of benefit.
- There is a major difference of effect between benefits arising at the time of timber harvest, and those non-consumptive *benefits* which increase in relative value with both passing time and size of tree. The former's rotation tends to an asymptotic value, at the optimal rotation for whichever benefit attracts the lowest discount rate. The latter by contrast lengthens progressively and ultimately becomes indefinitely protracted, whatever the starting conditions. But conditions which increase the relative importance of timber revenues lead to an optimal rotation which is asymptotic through time to the optimal timber rotation.
- Eventually – if the factors causing the differential of discount rate persist – the rotation may be prolonged indefinitely. This indeed has happened already in some forests and some stands in many forests where non-consumptive values dominate. “Long-term retentions” represent a management category which recognises this factor. Differential discount rates simply reflect a slow shift in forest values that will bring a greater proportion of forest area into this category. Consequent reductions in timber supply should bring about its own premia on timber, which may balance or even reverse the indicated trends, to follow a rotation pattern as shown in figure 6.
- While the path of values in the very long term is of course hard to predict, the examples above suggest that this should not be a major problem for forest managers. If non-market benefits are already sufficiently important, they will already determine the optimal rotation. If they are only expected to become important in the rather distant future, there is no need to deviate much from the present rotation for timber. The indicated progressive lengthening of rotation is slow at first, and adjustments can be made as the prospect over the coming rotation seems to indicate.
- Shifts in rotation, if semi-permanent, do bring problems for maintaining normal age-class structure. For those stands which have little environmental value, short-term shortfalls of timber production may be compensated by somewhat early final felling, together with thinning of the retained stands where this is compatible with their non-consumptive use.

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Author's note: This paper was presented at the 2012 meeting of Scandinavian Society of Forest Economics and submitted for publication in the proceedings, but through some accident did not appear then.



# Optimal even-aged harvesting with multiple product classes

Richard J. Brazee<sup>1</sup>, Puneet Dwivedi<sup>2</sup>

<sup>1</sup>Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, Urbana, IL USA, [brazee@illinois.edu](mailto:brazee@illinois.edu)

<sup>2</sup>Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA USA, [puneetd@uga.edu](mailto:puneetd@uga.edu)

## Abstract

We develop and analyze a multiple products model that extends the Faustmann Model. Necessary and sufficient conditions for the optimal harvest age are presented. We show that the optimal harvest age may vary inversely with some product class prices, but must vary inversely with at least one product class price, which is in contrast to the standard Faustmann Model. We also show that that the optimal rotation age will more likely vary directly with products that require larger minimum diameter sizes. A numerical simulation based on a U.S. southern pine three product illustrates the possible impacts of the theoretical results.

**Keywords:** even-aged harvesting, diameter size, Faustmann rotation, land expectation value, multiple products

# Comparing the economic result of even- and uneven-aged forest management

Hietala, J., Kosenius, A-K., Rämö, A-K., Horne, P.

Pellervo Economic Research PTT, Eerikinkatu 28 A, 00180 Helsinki, Finland

## Abstract

The economic and ecological performance of different forest management options has been studied for decades. Rising emphasis on forest owners' objectives and more permissive regulations, have increased the interest in alternative management methods. This is evident also in research publications of recent years, which have been increasingly dealing with the topic. Studies especially for the Scandinavian boreal zone have produced widely variable results such that no clear answer to the superiority of alternative forest managements can be given. This has given rise to a lively debate around the subject.

This study aims to raise awareness of the various forestry practices by clarifying the discussion regarding economic result of different forest management regimes. The study presents a variety of economic indicators that can be used in assessing alternative management methods. This study clarifies how the financial performance of the two main forest management alternatives – even and uneven-aged management – has been compared in recent publications, and how to interpret the effect of various exogenous variables incorporated into models. The study is based on a literature review, consisting of peer-reviewed scientific research papers, books and articles written on the subject. A synthesis of the research results gives ground to the analysis of various factors affecting the relative economic performance of different management options. As theory and practice do not always coincide, interpretation of the results stresses the perspective of practical forestry.

**Keywords:** Forestry, economic result, even-aged management, uneven-aged management

# Forest Value and Optimal Rotations in Continuous Cover Forestry

Jette Bredahl Jacobsen<sup>1</sup>, Frank Jensen<sup>2</sup> and Bo Jellesmark Thorsen<sup>3</sup>

<sup>1</sup> Department of Food and Resource Economics and Center for Macroecology, Evolution and Climate Change, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, jbj@ifro.ku.dk

<sup>2</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, fje@ifro.ku.dk

<sup>3</sup> Department of Food and Resource Economics and Center for Macroecology, Evolution and Climate Change, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, bjt@ifro.ku.dk

## Abstract

The Faustmann forest rotation model is a celebrated contribution in economics, which provide forest value expressions and allow a solution to the optimal rotation problem valid for even-aged forest ecosystems. However, many forest management systems imply continuous forest cover. A number of numerical studies have analysed specific continuous cover forest ecosystems in search of optimal management regimes, but few have tried to capture key dynamics of continuous cover forestry in simple mathematical models. In this paper we develop a simple, but rigorous model of the continuous cover forest, which strictly focus on the important difference in area use dynamics such a forest has. The model allow for a simple expression for forest value and the derivation of conditions for the optimal rotation age. The model allows for comparisons with the well-known Faustmann model. We present results for unrestricted as well as area restricted versions of the models. We find that land values are unambiguously higher in the continuous cover forest models than in the Faustmann models. Under area restrictions, the optimal rotation age in continuous cover forest model is unambiguously lower than the corresponding restricted Faustmann solution. The result for the unrestricted model is ambiguous.

**Keywords:** Faustmann rotation model, capital budgeting, area use, uneven-aged management

# Wildlife reserves, populations and hunting outcome with smart wildlife

Frank Jensen<sup>1</sup>, Jette Bredahl Jacobsen<sup>2</sup> and Bo Jellesmark Thorsen<sup>3</sup>

<sup>1</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, fje@ifro.ku.dk

<sup>2</sup> Department of Food and Resource Economics and Center for Macroecology, Evolution and Climate Change, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, jbj@ifro.ku.dk

<sup>3</sup> Department of Food and Resource Economics and Center for Macroecology, Evolution and Climate Change, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, bjt@ifro.ku.dk

## Abstract

There is a very small natural resource economic literature on natural reserves and hunting that consider potential stress effects of hunting on the game population and its migration in and out of hunting and reserve areas. In this literature private optimal solution with and without stress effects is compared. There is no consideration on the social optimum. In this paper we consider both private and social optimum in the case where two-way migration between the hunting and reserve areas occur. Thus, migration depends on both hunting pressure and relative population densities. In the social optimum we reach ambiguous results when comparing a situation with and without stress effects. A pure stress effect implies that the population level in a wildlife reserve increase and the population level in the hunting area decrease in optimum. However, this change in optimal population levels increase migration from the wildlife reserve to the hunting area in the social optimum. The total effect is, therefore, ambiguous. For the private optimum open-access is assumed and exactly the same results arise as in the social optimum when comparing a situation with and without stress effects.

**Keywords:** Hunting, game, migration behavior, wildlife reserve, social optimum, and open access

# Motivations to leave coarse woody debris in private forests – a survey based study

Tove Enggrob Boon<sup>1</sup>, Henrik Meilby<sup>2</sup> and Anne Sofie Kirkegaard Andersen<sup>3</sup>

<sup>1</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, tb@ifro.ku.dk

<sup>2</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, heme@ifro.ku.dk

<sup>3</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, askierkegaard@gmail.com

## Abstract

There is a decline of biodiversity in Europe. Following the Biodiversity Convention (1992) EU countries, including Denmark, have agreed to a common EU 2020 target to halt the loss of biodiversity. In Denmark, forests play a major role for biodiversity conservation, as forests cover 14 % of the land area and half of the red listed species belong to forests. Of the forest area, 71 % is owned by private owners. Hereby private forest owners are key players in providing for biodiversity conservation in forests. But, what motivates the owner to take biodiversity conservation measures, with the possible costs and benefits incurred?

Based on the theory of planned behaviour, the aim of this study is to investigate forest owners' motivation to integrate nature concerns in forest management. As criteria for choosing a relevant case, we looked for a measure that has a potential to significantly improve biodiversity, has political attention, is tangible, constitutes something any forest owner can do even on a small area of land, involves potential trade-offs with other management goals, and, preferably something that most forest owners and their personal network would have an opinion about. Based on these criteria, we selected the case of leaving coarse woody debris on the forest floor. A survey questionnaire was designed and sent to 1434 private forest owners in Denmark, 686 of whom answered. The presentation includes the first results of the analysis.

**Keywords:** Theory of planned behaviour, dead wood, nature conservation, forest owners

# Least-cost allocation of measures to increase the amount of coarse woody debris in forest estates

Hans Ekvall<sup>1</sup>, Göran Bostedt<sup>2</sup> and Mattias Jonsson<sup>3</sup>

<sup>1</sup> Department of Forest Economics, Swedish University of Agricultural Sciences, Umeå, Sweden, Hand.Ekvall@slu.se

<sup>2</sup> Department of Forest Economics, Swedish University of Agricultural Sciences, Umeå, Sweden and Environmental and Resource Economics, and Umeå School of Business and Economics, Umeå University, Sweden, Goran.Bostedt@slu.se

<sup>3</sup> Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden, Mattias.Jonsson@slu.se

## Abstract

Coarse woody debris (CWD) is crucial for maintaining biodiversity in forests but conservation measures to increase CWD must be performed cost efficiently. We estimate least-cost combinations of CWD-increasing measures in a spruce-dominated Swedish forest estate. Specifically, we investigate how using combinations of the measures tree retention, creating high stumps, manual scarification, prolonged rotations, and retention of dying trees impacts the amount of CWD and net present value at the estate level. We found that by combining CWD-increasing measures in an optimal way the amount of CWD on the estate could be increased 322% with a decrease in present value of only 10%. The optimal combination of conservation measures depends on the desired increase in CWD. The analysis thus shows that huge improvements in cost-efficiency of biodiversity-oriented forestry are possible.

**Keywords:** Dead wood, Forestry, Forest estate, FSC, Picea abies

# **Influences of nonindustrial private forest landowners' management priorities on the timber harvest decision**

Claudio Petucco, Anne Stenger, Jens Abildrup

Lef INRA-Agroparistech

## **Abstract**

In recent years, there is a demand to increase the wood mobilisation from French private forests which are a significant part of the national wood supply. Non-industrial private forest (NIPF) owners are often not only timber producers, but also providers of forest amenities, from which they derive a private utility as well as positive externalities for the rest of the society. This could represent a limit to wood exploitation, since to some extent there is a trade-off between production and amenities. At the same time, the fragmentation of the forest property and the passive management of some private forest owners are restraining the wood supply. We propose an econometric analysis of the harvesting decision with particular attention to the role of NIPF landowners' management objectives. We defined four categories of management objectives: "production oriented", "production & amenities", "amenities oriented", and "no objectives", using a sample of 442 French NIPF landowners. The aim was to identify the relevant factors influencing this management action, and, in particular, the role of amenities-oriented objectives and no-objectives. Results showed that, a change in the management objective from production-oriented to amenity-oriented significantly reduced the probability of harvesting. The lack of management objectives as well as absenteeism, however, exhibited an even higher negative effect. Consistently with a utility maximisation framework, both economic variables (timber price and income) and landowners' socio-demographic characteristics were significant predictors of the harvesting decision. From a policy point of view, our results suggest to address incentives schemes on passive forest owners in order to increase wood production.

## **Forest Policy**



# **Sustainable development – international framework – overview and analysis in the context of forests and forest products with a stakeholder view – a literature review**

Annika Hyytiä

University of Helsinki, PL 27, 00014 University of Helsinki, annika.hyytia@helsinki.fi

## **Abstract**

Co-operation between different stakeholder groups is found important. Private owners have an important position and privately owned forests form a remarkable resource for forestry in Finland. Sustainable development is followed by several international organizations: for example the United Nations and the OECD with green strategies. Features of sustainable development may be found in the green concepts. Forests and forest products are presented with sustainable development characteristics in many national and international associations, linking to diverse ecosystems, in various programmes, standards and certification schemes. In the value chain from forests, forest certification is a market-based tool. The Corporate Social Responsibility strengthens corporate's profitability. Forests and forest products with sustainable development characteristics are represented internationally by organizations, in the national and international regulation as the EU regulation and in corporations with the customer social responsibility aspect.

The research method of this study is a qualitative study and a literature review.

**Keywords:** Sustainable development, stakeholders, Corporate Social Responsibility (CSR), forests and forest products, certification, green business

## **Introduction**

This study is based on articles from relevant databases which include for example Academic Search Complete (EBSCO), Agris, CAB Abstracts, SCOPUS (Elsevier) and Web of Science (ISI). Also Internet sites, Google Scholar and literature of the relevant fields like international and country specific policy and regulation have been used to compose the review. The study is a descriptive review. It is not strictly but broadly outlined. It is a qualitative study. It combines organizational information and research information. The focus has been on sustainable development in the field of forest related international framework in the context of forests and forest products. Greenness in business and organizations is an actual theme in the sustainable development area.

## **Forest owners in a stakeholder approach**

New forest act of Finland gives more choices and opportunities for a forest owner and strives for the sustainability with economic, social and ecological aspects.

Finland's non-governmental stakeholders include the private forestland owners, industry, environmental groups, customers, professional forestry establishment and labour. In Finland, there is active international forest co-operation with stakeholders.

Forest owners form a major group benefiting from income generated in the forest sector. The private sector is recognized as a key actor for developing sustainable forest management in the

Integrated Programme of Work of Green Economy Action Plan. A research of Finnish forest owners reveals that multi-goal forest owners prevail with 30% dominance. This group entails mainly countryside entrepreneurs, people living in the countryside and people who own large forest areas.

Results of a research “Forest owners’ social networks – possibilities to enhance knowledge exchange “in which forest owners and their stakeholders with a social emphasis were analyzed show that owners’ social networks were most expanded when making protection agreements or timber trade in a group. It is also typical that forest owners have trusted professionals as stakeholders also in a decision making team.

In a Nordic context, there has been found participatory and marketing effectiveness in the certification schemes. Group certification enhances family forest owners’ participation.

Forest certification in Finland is based on the ministerial conference in Helsinki in 1993 where criteria and indicators for European sustainable forest management were discussed. International aspects and stakeholders have been taken into consideration early on. Policy has had an important role. In Finland, the FFCS standard (now the PEFC) was developed in 1998. The PEFC was founded in Paris in 1999. For its instrumental benefits it is also suggested that forest certification should be at the top of the sustainability agenda. The PEFC strives for a system suitable for small- and medium-sized family forestry. In regards to wood resources, the Finnish Forest Industry has committed to support internationally recognized forest certification which is applicable to the national environment and conditions, and to do co-operation with the stakeholders.

## **International approaches with responsible private sector engagement and trade**

International initiatives in the organizations of the United Nations and the European Union have a remarkable significance on the development of national forest programmes, the forest act, the forest cluster and the competitiveness of Finland. EU policy-making has significance with regard to national forest policy networks on the one hand because several EU policies affect the forest sector either directly or indirectly.

EU is a significant player on the global timber market. There are two main pillars of FLEGT: a legality assurance system and the governance reform in timber producing countries. The concept of illegal logging is multidimensional. The European Union with the due diligence regulation and the US with the Lacey Act Amendment guide the imports. Legal wood supports national forest sectors. In the European Union, Forest Law Enforcement, Governance and Trade Action Plan concerning markets, trade, economic development and the relation between different instruments and conventions nationally and internationally offers amongst others possibilities for collaboration. The regions and countries which altogether contain nearly 60% of the world’s forests supplying a large proportion of internationally traded timber include Central Africa, Russia, Tropical South America and Southeast Asia. International processes are the key to the development of a global forest sector. International stakeholder approach in the sustainable development is a goal in the Forest Europe Process. Stakeholder collaboration is present also in the Green Economy approach. New markets are expected. International processes and agreements have an important position. Technological development is expected to increase the export of forest products.

FLEGT has a position in the global forest regime in the national implementation. Legality verification has a significant potential for reinforcing both global private certification and

domestic governance. Forest certification has been counted to have a major contribution as to FLEGT internationally.

Timber procurement policies are introduced in response to public concerns in consumer countries about the environmental impacts. Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan is to create more responsible wood product framework in Europe to avoid importing of illegal roundwood. Developing stronger product and corporate brands to strengthen corporate environmental and social sustainability is suggested.

Fostering sustainable forest management certification globally is found important. Imported wood is estimated to be an important raw material source also in the future. Documents in the area of sustainable development in the forest sector in the European Union include the document Regulation (EU) No 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market. In the following are listed countries with biggest value altogether in euros of the import in 2006–2010 according to the mentioned timber and timber product items outside the EU:

Russia 2 911 290 509 €,  
China 100 671 604 €,  
Uruguay 95 055 526 €,  
Brazil 73 181 098 €,  
Canada 60 410 991 €,  
Belarus 54 162 238 €,  
USA 49 345 757 €,  
Norway 41 606 335 €, and  
Malesia 31 153 218 €.

According to the regulation, an operator means a natural or legal person placing timber or timber products on the market. Organizations of operators interact with a diverse range of stakeholders. According to the regulation the traceability of timber and timber products is highlighted in the supply chain.

According to the UNECE, by May 2012, 51% of the certified forest area was in North America, 25% in the EU/EFTA region and 12% in other Europe and the CIS and 13% across the southern hemisphere. World's forest product markets have become increasingly interrelated.

### **Stakeholder collaboration in a policy framework**

Cubbage et al. discuss natural resource policy tools in “Policy instruments to enhance multi-functional forest management“ and state that policy tools must adapt to achieve the goals of multi-functional forestry goals taking also into consideration the stakeholder groups, a broad range of ownerships and values.

Collaboration between stakeholders is found important. Stakeholder collaboration is present in the Finland's National Forest Programme. Finland has also been actively collaborating in international forest arrangements. The importance of intergovernmental ministerial agreements have been recognized as remarkable developments, for example the ministerial forest conference in Helsinki in 1993. Forest programs have an increasing importance in linking the inter-sectoral collaboration. The promotion of sustainable exploitation of natural resources is based in the National Natural Resource Strategy. Objectives in strengthening sustainable economic growth and competitiveness are included in the Programme of the Finnish Government.

Strategies in the forest policy have a link to new forest sector products including new technology, constructing, bio-based economy and new future of the forest sector. Opportunities for forestry and the forest industry and the related industries as well as the role of green investments have been emphasized in green and bio-based economy. The vision for the Forest Sector in a Green Economy includes giving the ground for sustainable production and consumption of forest products in the Policy Development and monitoring of the forest sector in relation to a green economy. Conservation of natural capital and efficient use of resources belong to the areas of Green Economy. Sustainable production and consumption of forest products includes for example certification of sustainable forest management and related labelling as well as other standards for sustainable forest management. The OECD recommends in greening the growth to improve the economy, protect the environment, and reduce global inequality.

In the Nordic region, the Green Growth is one of the main incentives in the sustainable development collaboration. The Nordic “Green Growth” includes bioeconomy initiatives and energy questions. Nordic partnership between Finland and Sweden is enhancing Green Economy solutions: there is worldwide demand for services and products. Possible strategic responses to driving forces affecting the forest industry include economic growth and globalization. European trade policy which is a core component of the EU’s 2020 strategy aims to increase the EU’s competitiveness: it includes sustainable growth and a contribution to the Green Growth in the EU and worldwide.

The new European Union Forest Strategy includes objectives which include ensuring and demonstrating that all forests in the EU are managed using the sustainable forest management principles. The aim is also to reduce deforestation, to foster competitiveness and sustainability of the EU’s forest-based industries and to ensure the protection of the forests.

## Discussion and conclusions

Diverse international sustainable development concerns both forest and forest products and strives for ecological, social and economic sustainability. Forest policy strategies have a link to new forest sector products including new technology, constructing, bio-based economy and new future of the forest sector. Opportunities and the role of forest industry and related industries as well as the role of green investments have nowadays been emphasized in green businesses. Sustainable development approaches seem increasingly interrelated taking account the main driving forces affecting the forest sector. Responsibility can be maintained from the forest owner till the corporation for example by forest certification. The Corporate Social Responsibility has a link to environmentally sustainable green initiatives and concepts. Multi-stakeholder aspects are common and are found important and have also international perspectives. Green business in organizations is an actual theme in the sustainable development area. It has many new solutions for the future.

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# Common Properties and Municipalities: institutional relations in forest environmental services provision. A case study in an Alpine Region

Matteo Favero<sup>1</sup>, Paola Gatto<sup>2</sup>, Davide Pettenella<sup>3</sup>

<sup>1</sup> University of Padova, Dept. of Land, Environment, Agriculture and Forestry (TESAF). Viale dell'Università, 16. 35020 – Legnaro (PD), Italy. Email address: [matteo.favero86@gmail.com](mailto:matteo.favero86@gmail.com)

<sup>2</sup> University of Padova, Dept. of Land, Environment, Agriculture and Forestry (TESAF). Viale dell'Università, 16. 35020 – Legnaro (PD), Italy. Email address: [paola.gatto@unipd.it](mailto:paola.gatto@unipd.it)

<sup>3</sup> University of Padova, Dept. of Land, Environment, Agriculture and Forestry (TESAF). Viale dell'Università, 16. 35020 – Legnaro (PD), Italy. Email address: [davide.pettenella@unipd.it](mailto:davide.pettenella@unipd.it)

## Abstract

In recent historical periods, Italian Common Properties have faced some attempts to weaken their institutional role, because of their assumed inability to promote technological and economic development in the forestry and agricultural sectors. More recently, both national and regional institutional reforms led to a renewed recognition of their position in rural development. In North-East Italy the Veneto Region undertook a set of initiatives to sustain such a policy process, and new Common Properties, managing mainly forest and range lands, have been created when local citizens have been able to demonstrate their original tenure rights before the Napoleonic land property reform.

However, the real commitment to the ambitious requests of the regional law and the actual forest management activities carried out by Common Properties are a matter of discussion: contrasting results emerged from recent surveys organized within the EC-funded NEWFOREX and INTEGRAL projects, with different levels of environmental services provision. Efficiency, inclusivity, transparency of new Common Properties are affected by patchy and different local dynamics. In some cases institutional conflicts exist between Municipalities and Common Properties and a better coordination between these local institutions should be promoted.

This paper presents the results of a comparative analysis of motivations and concrete actions of Common Property leaders, collected through a semi-structured questionnaire proposed to the representatives of those Common Properties located in the same areas where a recent parallel survey has been conducted for Municipalities. The degree of cooperation between Municipalities and Common Properties is therefore assessed, trying to understand whether reported institutional conflicts can be considered sporadic or more structural situations.

**Keywords:** Common Property, Municipality, institutional coordination, forest management, Veneto Region

## Introduction

Since the 19<sup>th</sup> Century, the institutional role of Italian Common Properties in rural areas has been progressively weakened by past governmental action, on the grounds of their alleged inability to promote technological and economic development in forestry and agriculture. Particularly, the fascist regime tried to abolish the common regime and its own collective peculiarities, and Common Properties (CP) were placed under Municipal Administration (MA).



Today, a new wave of devolution and institutional reorganization puts new focus on the role of forest CP in ensuring environmental conservation and supporting socio-economic development of mountain areas (Favero et al. in press; Gatto et al. 2012).

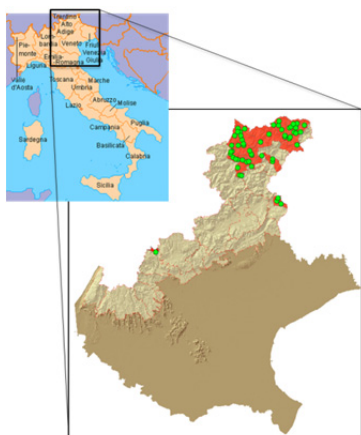


Figure 1. Veneto Region and location of the Common Properties

In the North-East of Italy the Veneto Region undertook a set of initiatives to sustain a policy process of renewed recognition of the CP role in rural development. As a consequence, 'new' CP managing forest landscapes have been restored when local citizens succeeded in providing evidence of their original tenure rights, set in place before the Napoleonic land property reform and other consecutive hostile legislative initiatives. Figure 1 shows the location of the CP within the regional boundaries. Meaningfully, the first clause of the regional law (Regione del Veneto 1996), enacted to reform the discipline on Common Properties, states that *'the Veneto Region recognizes Common Properties as mountain organizations concurring to the environmental protection and to the socio-economic development of mountain territories'*, and

the Region *'[...] promotes the reconstitution of ancient CP, in order to foster policies aimed to stimulate investments in the agriculture and forest sector'*.

Despite the new formal acknowledgement of their institutional and statutory autonomy, and the relevant responsibilities delegated to the CP, the socio-economic environment of mountain areas has greatly changed compared with the past. At least until the early 1950s, forest resources were under more intense harvesting regimes than today, as they played a fundamental role in ensuring the basic means of subsistence to mountain communities. In the following years, radical socio-economic changes occurred throughout the country, including in the Veneto region, with the increased role of the industrial and tertiary sectors, the urbanization process and emigration from marginal areas. Consequently, forests progressively lost their essential role in ensuring livelihoods of the mountain rural population. Thus, whereas forests expanded and almost doubled at a national level, pastures and range lands decreased, along with the traditional grazing activities: in several cases, they even ceased being a peculiar trait of rural landscapes. In parallel, forest production value dropped over the time: industrial roundwood supply lessened, only partially and recently counterbalanced by increasing fuelwood removals (Ciotti and Pettenella 2005). Whereas the role of timber supply reduced, other environmental services (ES) and products progressively gained relevance within the Italian forest sector (Pettenella and Secco 2006): these include, protection from natural hazards (>90% of Italian forests extend over high hydro-geological risk areas), biodiversity protection, water cycle regulation and carbon storage, and nature-based recreational activities. Although in the Veneto mountain area (i.e. the Dolomite region, now a UNESCO site) vast uneven-aged high spruce, fir and beech forests now have high potential for industrial roundwood supply, wood removals count for less than 30% of the net annual increment and winter and summer tourism is by far the main source of income for the local population.

In this radically changed context the real mandate defined by the regional law to the old and new CP and their response in terms of land management activities are a matter of discussion. On this point, Gatto et al. (2013) argued that *'the traditional tools which the communities have given themselves to manage their resources might today not always be sufficient to adapt to external change and disturbances'*. Among the other external changes and disturbances, the recent inflow of newcomers (retired people, non-EU immigrants, distance workers, commuters,

young urban “alternatives”, etc.) appears of real importance (Figures 2 and 3), as it seems capable of reversing the demographic decline in many mountain areas, due to emigration and an ageing population. Thus, the commitment and management options of CP in relation to the objectives and responsibilities that the regional law entrusts them with, is worth assessing.

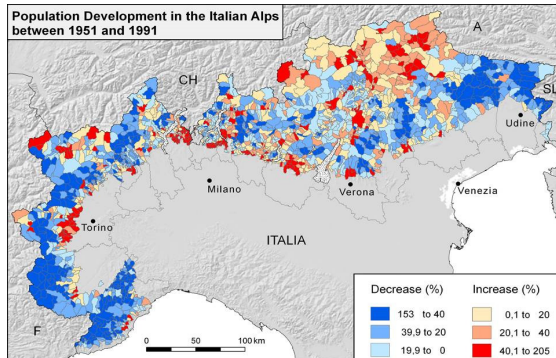


Figure 2. Population development in the Italian Alps between 1951 and 1991. Modified from Steinicke et al. 2014

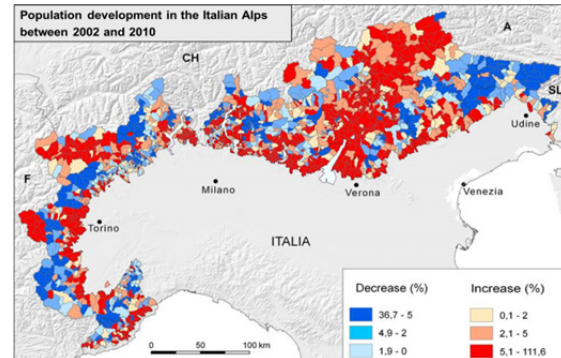


Figure 3. Population development in the Italian Alps between 2002 and 2010. Modified from Steinicke et al. 2014

## Objectives and Methodologies

This survey firstly aimed to evaluate whether the outcomes of the re-assignment of former municipal forests to CP can be considered positive in terms of improved forest management practices and ES supply. The MA and CP commitment and attitude towards the provision of ES other than wood, have therefore been assessed and compared. The following ES were selected: biodiversity protection, carbon storage, soil protection and water quality regulation, tourism promotion and support to recreational activities. Interviews were based on a semi-structured questionnaire. In particular, it has been assessed whether CP and MA explicitly consider the selected ES among their current multi-functional forest management practices. The assigned priority to ES supply was also tested analysing whether they consider such provision as a primary or secondary forest management objective. Finally, respondents declaring no or secondary commitment to ES supply were asked to indicate whether they would be potentially interested in strengthening their attitude towards ES provision, and under what conditions. Within the regional boundaries, face-to-face interviews were conducted with private, public, and CP forest owners and managers. The total number of respondents equalled 197, randomly selected from among the whole regional forest owners' population. Of these, 18 interviews were selected first, those with CP representatives – mostly Presidents or Secretaries (out of 53 regional CP units; coverage: 34%). Interviews with municipal representatives were then selected, according to a geographical closeness criterion linking Municipalities with those CP lying within their administered areas. 11 interviews with municipal representatives were considered, whereas 12 others were excluded as no information on CP had previously been collected in the surrounding areas. It should be stressed that data collection followed the research design and methodology suitable for and connected to the EU-FP7 Newforex Project (New Ways to Value and market forest externalities), which encompassed a variety of objectives and research questions going far beyond the aims of this paper (see [www.newforex.org/](http://www.newforex.org/) for further information). Data collection and sampling methods were therefore not specifically designed to cover the regional CP population, introducing some degrees of statistical error in data elaboration. Having proved that no other similar surveys had previously been conducted on the same topic, a qualitative and explorative approach was preferred in the results analysis. The main findings were also cross-checked with data collected

during other surveys, briefly described hereinafter. Any statistical inaccuracies do not therefore seem to be causing any misrepresentation of the main figures and results.

The second research aim was to evaluate the degree of cooperation between MA and CP, trying to understand whether reported institutional conflicts can be considered sporadic, or more structural situations. In fact, some Authors suggested that the coexistence of these institutions is based on a weak equilibrium (Florian 2004; Carestiato 2008; Hampel 2012), thus possibly hindering CP capability to supply 'new' ES. Institutional relationship patterns between CP and MA have therefore been assessed, comparing their representatives' positions, collected through semi-structured questionnaires. This research step took advantage of the EU-FP7 Integral project activities (Future-oriented integrated forest management of European forest landscapes, see [www.integral-project.eu](http://www.integral-project.eu) for further information). The sampling selection method was rather comprehensive and accurate: all CP-affected Municipalities were contacted, and the response rate was 82% (14 out of 17 MA), covering ~70% of the whole regional CP population (37 out of 53 CP lying within their administered areas). Respondents were identified among the officers mainly responsible for the institutional contacts with local CP (10 times the Mayor, twice an alderman, one municipal secretary and one office manager). Representatives of the CP were also contacted. Globally, 18 representatives of different CP were approached and interviewed. Sampling criteria were the following: (i) geographical area (vicinity to the already contacted MA), (ii) year of establishment, with both long-lasting and new CP re-established after L.R. 26/1996, (iii) results emerged from previous data collection and (iv) political and economic significance of the CP (avoiding very small and irrelevant CP). 13 of the contacted people were CP presidents, once the vice-president, 4 times the administrative assistants. The person in charge of institutional contacts was identified, the stability and qualitative patterns of this relationship, and which difficulties mainly hinder the institutional dialogue and cooperation. Recurrence of legal disputes was explored, along with the perceived level of institutional constraints due to their compulsory administrative relationship. Overlapping competences potentially triggering institutional contrasts were also evaluated. Finally, municipal interviewees were asked to evaluate CP effectiveness in promoting tourism, economic and social development of mountain areas, environmental protection and forest management. CP representatives operated the same self-evaluation. Such data were helpful to integrate and cross-check information collected in the previous desk-research phase.

## Results and Discussion

Interviewees were asked to indicate whether they considered the provision of ES other than wood compatible with the ongoing forest management practices, along with their inclusion in the current management goals and their assigned 'priority level'. Table 1 shows the related results. Interestingly, almost all the interviewees, both CP and MA representatives, were convinced that current forest management practices are compatible with the supply of selected ES. A few municipal representatives gave negative answers referring to carbon storage (9.1% of times conflicting with current forest management actions) and soil protection (20.0%). The judgment was clearer concerning the inclusion of investigated ES within the current forest management goals and plans: somehow, ES are always taken into consideration, with the only exception being carbon storage (6.7% of negative answers among municipal representatives). Nonetheless, MA and CP representatives' positions differed considerably with reference to the assigned 'priority' given to provision of each single ES. In fact, in many cases MA representatives designated such ES as 'main' forest management objectives; on the contrary, CP interviewees often described them as subordinate to wood supply. This particularly applies to tourism and recreational activities and carbon storage.

Other figures confirmed a rooted CP commitment to wood supply: timber selling revenues have been described as representing almost the entirety (71.4% of times), or a relevant share (21.4%),

whereas MA representatives described them as 'not very relevant' (28.6%, opposed to 7.1% for CP), or 'negligible' (71.4%) if referred to the whole municipal financial budget.

Table 1. Compatibility between ES provision and ongoing forest management practices, ES inclusion in the current forest management goals, and related assigned 'priority level

ES types	Organization	ES supply compatibility with current forest management		ES supply embodied within current forest management goal		ES supply priority (main or secondary forest management goal)	
		No	Yes	No	Yes	Main	Secondary
Tourism and recr. activity	MA	0.0%	100.0%	0.0%	100.0%	88.9%	11.1%
	CP	0.0%	100.0%	0.0%	100.0%	14.3%	85.7%
Biodiversity	MA	0.0%	100.0%	0.0%	100.0%	90.0%	10.0%
	CP	0.0%	100.0%	0.0%	100.0%	66.7%	33.3%
Carbon storage	MA	9.1%	90.9%	6.7%	93.3%	50.0%	50.0%
	CP	0.0%	100.0%	0.0%	100.0%	7.7%	92.3%
Soil protection, water quality	MA	20.0%	80.0%	0.0%	100.0%	80.0%	20.0%
	CP	0.0%	100.0%	0.0%	100.0%	66.7%	33.3%

Interviewees declaring no ES inclusion within current forest management objectives, or who assigned secondary relevance to such services and objectives, were also asked to indicate whether they were potentially interested in strengthening their commitment to supply such services, and under what conditions. Table 2 shows the related results. Uncertainty prevailed with reference to tourism: most interviewees, both MA (100%) and CP (66.6%), demonstrated that they do not know how recreational activities could be better linked with forestry interventions. Notably, 26.7% considered the proactive increase of biodiversity levels not applicable within their forest areas, or were not interested in such a commitment (13.3%). However, many interviewees were potentially favourable to further focussing on biodiversity even without direct earnings, simply by adjusting their forest management actions. On the one hand, interviewees broadly considered carbon storage compatible with current forest management actions, but they definitely saw it as secondary to timber provision; on the other hand, many stated that they would commit themselves to provide higher carbon storage levels only if associated to direct earnings (50% among MA and 40% among CP), and many others considered this goal not applicable to their forest areas (40% MA and 33.3% CP). Differently from the other ES, in the vast majority of cases soil protection and water quality were described as primary forest management objectives, and highly compatible with current forestry practices. Nonetheless, the future interest in higher proactive ES supply levels followed similar trends to those for carbon storage, that is little interest in doing more without direct payments.

Table 2. Potential interest in supplying higher ES levels, and under what conditions. Question targeting respondents declaring no ES inclusion within current forest management objectives, or assigning them secondary relevance

ES types	Future ES supply (attitude)	MA	CP
Tourism and recreational activities	Yes, with direct earnings	-	16.7%
	Yes, also with no direct earnings	-	-
	Yes, with indirect profits	-	16.7%
	No, I think it is not applicable	-	-
	No, in any case	-	-
	I don't know	100.0%	66.6%
Biodiversity	Yes, with direct earnings	10.0%	20.0%
	Yes, also with no direct earnings	60.0%	26.7%
	Yes, with indirect profits	-	6.7%
	No, I think it is not applicable	30.0%	26.7%
	No, in any case	-	13.3%
	I don't know	-	6.7%
Carbon storage	Yes, with direct earnings	50.0%	40.0%
	Yes, also with no direct earnings	-	-
	Yes, with indirect profits	10.0%	-
	No, I think it is not applicable	40.0%	33.3%
	No, in any case	-	-
	I don't know	-	26.7%
Soil protection, water quality	Yes, with direct earnings	33.3%	40.0%
	Yes, also with no direct earnings	33.3%	13.3%
	Yes, with indirect profits	-	13.3%
	No, I think it is not applicable	22.2%	33.3%
	No, in any case	-	-
	I don't know	11.1%	-

MA representatives were then asked to evaluate CP effectiveness in promoting social and economic development, tourist promotion and environmental management within their administered areas. Figure 4 shows the results, displayed in ascending order from left to right, from the worst to the best overall evaluation. Likewise, CP representatives were asked to rate their own effectiveness (self-evaluation); the results are shown in Figure 5.

The most positive evaluations concerned the CP environmental management impacts: MA representatives often admitted that forest management has improved since CP took over this responsibility, given that it constitutes the CP *core business*, whereas MA also have many other fields of interest to deal with. However, along with some favourable comments, some MA representatives stated that the entrepreneurial attitude of some CP seems far from being fully realized, i.e. mainly limited to timber selling. Negative opinions prevailed in relation to tourist promotion: they observed that commoners are often still tied to old mentality and behaviour, closely related to forestry and pasture management, therefore not oriented towards new strategies of territorial marketing, landscape management and rural tourism development. The

most critical judgments concerned CP capability to promote social development: 78.5% of given answers were negative opinions. In fact, interviewees mostly stressed four critical issues: (i) difficulties of non-commoners in entering CP and being accepted as CP members, even if they have been living in the local area for decades; (ii) exclusion of non-rights holders from some common resource benefits (e.g. access to grants for young newly married couples, to scholarships, to building subsidies, etc.), thus creating some social contrasts; (iii) some commoners' hostile attitude towards outsiders, namely tourists and people living elsewhere; and (iv) absent or weak gender balance, given that in some cases females are still not allowed to represent their household in the CP Assembly.

The most obvious gap between commoners' point of view and municipal representatives' opinions occurred with reference to the social issues. In fact, commoners asserted that their effectiveness in promoting social development is secondary only to the environmental management. In fact, they mainly stressed that CP induce social cohesion within local communities, reinforcing their identity as members of the community, which is particularly important for small and isolated mountain villages. They also argued that the provision of some products and services is also granted and extended to non-commoners, even though high variability exists among CP Statutes, with quite a patchy geographical situation. In addition to their assumed ability in uniting the local community, commoners also recalled their proactivity in the organization of several events and public initiatives – ranging from cultural, enogastronomic, to religious ones – where the whole community is encouraged to participate. Finally, some of them admitted that in the past contrasts between commoners and non-rights holders led to some conflicts, also including some forms of exclusion, but they also observed that most of the time such 'past issues' have been overcome and solved. Apart from social development, commoners sorted the other issues in the same descending order as that chosen by municipal representatives, i.e. environmental management, economic development and tourist promotion. Nonetheless, and as expected, they were slightly inclined to assign higher scores to their own actions.

The collected data revealed a high recurrence of legal disputes between MA and CP, mainly concerning the definition of property rights over land, assets or buildings. Litigations were often triggered by the inaccuracy of cadastral information. In some cases such controversies have already been solved, but many are still ongoing. Other institutional conflicts concerning the formal allocation of some particular responsibilities, e.g. issue of permits to access forest roads, also came to light. The severity of such institutional frictions was mainly described as reasonable (57.1%), whereas it was considered relevant or heavy by 14.3% and 28.6% of interviewees respectively. Figure 6 summarises the occurrence of legal disputes and institutional conflicts between MA and local CP.

The regional law designates CP as a subject '*concurring*' to the management and development of mountain areas, and it also sets some mandatory mechanisms of institutional coordination with MA. In fact, on the one hand, Municipalities hold the overall administrative authority within their municipal boundaries, on the other, CP often own the vast majority of forests and farmlands lying outside the urban centres. Thus, both CP and MA representatives were asked to indicate how severe they perceive the limits and constraints connected to such legislative requirements on their own management. Figure 7 displays the related results. Unexpectedly, the opinion prevailed that a 'compulsory' coordination does not pose heavy limitations to each one's autonomy and ordinary management.

Finally, the results demonstrated that CP are always represented within the local municipal Assembly. In fact, in every Town Council at least one Councillor, Alderman or even the Mayor (9 times out of 14) is also a commoner, or alternatively a commoner's offspring who usually participates in the CP Assembly on behalf of the head of the household. It often resulted that

one single municipal representative is responsible for maintaining formal contacts with local CP (5 times the Mayor, once the Deputy Mayor), whereas in four other cases one Alderman or the Deputy Mayor reinforce the Mayor's role. In only 3 cases the institutional contacts originate from a collegial effort, through the involvement of the whole Town Council. On the CP side, a main role is played by Presidents (17 out of 18 cases), eventually supported by the Vice-President (6), Secretaries (5), or Administrative Board members (6).

All in all the creation of new CP can be considered a positive process in terms of both increased provisioning services (wood harvesting), with the related positive impacts on the local economy, and in the supply of public or common ES. Some problems of the CP are related to their social inclusiveness; in a territory with remarkable demographic change this is a traditional "half empty or half full glass" issue: CP are able to keep their traditions and rules in land management, preventing any land use change, but at the same time they exclude the newcomers, with their innovative ideas and programmes.

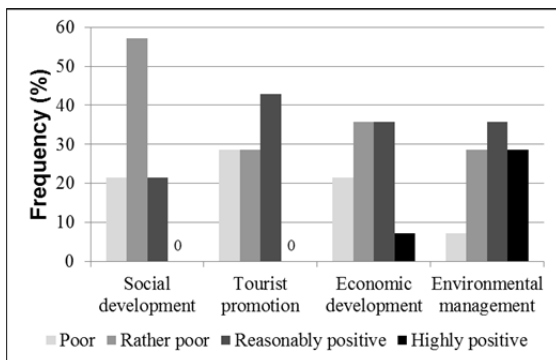


Figure 4. Municipal representatives' assigned rate to CP effectiveness in promoting social and economic development, tourist promotion and environmental management

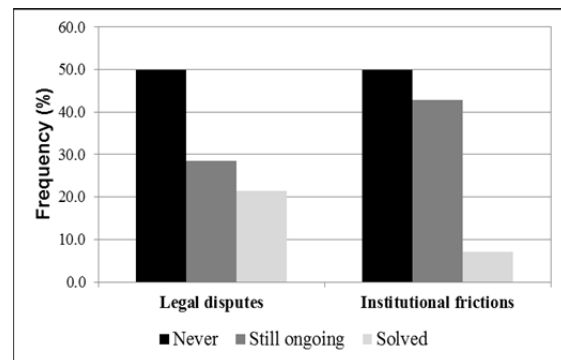


Figure 6. Occurrence of legal disputes and institutional contrasts between MA and local CP

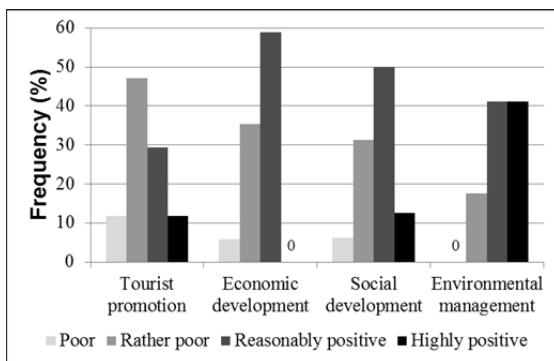


Figure 5. Self-evaluation of CP representatives of their own CP effectiveness in promoting social and economic development, tourist promotion and environmental management

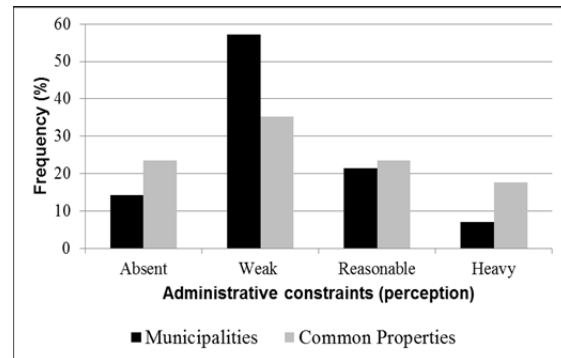


Figure 7. Perceived severity of limits and constraints on each one's ordinary management, and ascribable to compulsory mechanisms of institutional coordination

## Conclusions

Results suggested that CP seem more committed to traditional forest management than Municipalities, thus the re-establishment of 'new' CP may reinforce the main provisioning services, i.e. wood harvesting. However the dichotomy "CP focussed on market-based activities vs. MA focussed on ES provision" does not hold for at least two reasons: (i) in the highly regulated Italian forest sector, MA tend to abandon or to make a more extensive use of their forests, actively managed for centuries and now ageing and thus increasingly vulnerable, resulting in a reduced provision of some ES. On the contrary, active CP forest management more oriented to wood production can indirectly support the provision of some ES (landscape conservation, carbon storage, soil stability). (ii) because of institutional arrangements and, especially, of constitutional rules of CP, only 10% of profits deriving from forest management activities by MA are reinvested in the forestry sector, while in the case of CP almost all profits have to be reinvested in land resources improvements.

Interviewees mainly perceived forest-related tourism as not really included in the existing forest management plans, and forest landscapes are simply thought to be the essential *substratum* needed for local tourism. Differently, no evident trade-offs between wood provision and carbon storage service appeared. Biodiversity was perceived as a sort of forest management spill-over, not necessary to be further proactively fostered through *ad hoc* interventions. On the one hand, soil protection appeared to be a sort of forest management pre-requisite, on the other, it was described as an implicit management side-line.

Strongly different opinions on CP ability to promote social development have been registered between CP and MA representatives. Whereas a new open attitude recently began to prevail, CP still remain quite effective in mainly catering for the interests of commoners and protecting the *status quo* in forest land use. In a changing society with a lot of newcomers, perhaps CP should commit themselves to promoting social models as 'inclusive' as possible. It is likely that new demographic trends will lead Common Properties to develop new rules and criteria to possibly accept new members within the CP Assembly.

Institutional conflicts are frequent. Nevertheless, a mutual willingness to reach friendly agreements has recently prevailed. Resolution of litigations has been revealed to be a relevant driver for cooperation and establishing more sound institutional relationships. Such resolutions should therefore definitely be pursued by both the contending parties. Interestingly, CP representativeness within the municipal administration is not a discriminating feature in setting up positive or negative institutional relationships, even though it represents a positive integration of these two local Institutions. Rather, formal mechanisms aimed to enhance and support mutual cooperation are needed: indeed, the results suggest the importance of formal and informal contacts being between more than just one municipal and CP representative. Otherwise, if the institutional relationship is reduced to individual and personal contacts, the robustness of the whole institutional relationship may suffer from any worsening of these 'private' contacts. To this end, mechanisms to enforce stable, robust and enduring cooperation (e.g. joint declarations of interest, procedural and/or economic memoranda and agreements, etc.) are worth implementing.

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# Explaining participation of private forest owners in economic incentives. Case studies in Europe

Górriz, E.<sup>1</sup>, Mäntymaa, E.<sup>2</sup>, Petucco, C.<sup>3</sup>, Schubert, F.<sup>4</sup>, Vedel, S. E.<sup>5</sup>, Mantau, U.<sup>6</sup> & Prokofieva, I.<sup>7</sup>

<sup>1</sup> Forest Sciences Center of Catalonia (CTFC). European Forest Institute – Mediterranean Regional Office (EFIMED). St. Pau Historic Site, St. Leopold Pavilion, c/St. Antoni Maria Claret 167, 08025 Barcelona, Spain. elena.gorritz@ctfc.es

<sup>2</sup> Finnish Forest Research Institute (METLA). PO Box 16 (Eteläranta 55), 96301 Rovaniemi, Finland. MTT Agrifood Research Finland. erkki.mantymaa@mtt.fi

<sup>3</sup> INRA, UMR 356 Economie Forestière, 54000 Nancy, France. AgroParisTech, Laboratoire d'Economie Forestière, 54000 Nancy, France. claudio.petucco@nancy.inra.fr

<sup>4</sup> University of Hamburg. Leuschnerstr. 91, 21031 Hamburg, Germany. schubert808@googlemail.com

<sup>5</sup> University of Copenhagen. Rolighedsvej 23, 1958 Frederiksberg C, Denmark. sve@ifro.ku.dk

<sup>6</sup> University of Hamburg Leuschnerstr. 91, 21031 Hamburg, Germany. mantau@holz.uni-hamburg.de

<sup>7</sup> Forest Sciences Center of Catalonia (CTFC), St. Pau Historic Site, St. Leopold Pavilion, c/St. Antoni Maria Claret 167, 08025 Barcelona, Spain. irina.prokofieva@ctfc.es

## Abstract

Taking part in the implementation of a voluntary policy instrument for land use management implies motivational requirements of the targeted landowner. Increasing knowledge on the potential economic, managerial and attitudinal factors helps design incentives in accordance and facilitates an effective performance. We analyzed surveys and interviews addressed to private forest owners, at country or regional level in five European countries. Participation rates for different schemes aimed at enhancing the provision of ecosystem services were contrasted with a range of landowners' socio-economic, forest management variables, as well as with the instrument design characteristics.

Results show larger participation trends in mechanisms that promote a forest ecosystem service while simultaneously augments benefits enjoyed by the landowner. Being involved in some type of forestry association increases the likelihood of engaging in the policy mechanism, especially for small and medium size landowners. Correlation patterns were found for variables representing active forest management and activity-enhancing instruments.

We argue that these factors explain an alignment of the landowner either with the instrument objectives or the land management measures they promote. It demonstrates that the design of mechanisms bolstering synergies between current landowners' practices and expectations to those demanded by externals have more likelihood of success than those implying drastic management changes. On the other hand, this pre-existing alignment may challenge the efficiency of the policy intervention if most of the expected added value would require targeting not aligned landowners.

**Keywords:** policy instrument, active forest management, cooperation, instrument design

## Introduction

Most forest ecosystem services (ES) demanded by society tend to exhibit public good characteristics (difficulty to exclude, no rivalry) and they are not traded in a conventional market. As a consequence, private forest owners (FO) cannot reap the benefits and hence may have no incentives to provide them. Modern governance approaches promote voluntary schemes aimed at enhancing forest ecosystem service provision, whereby participating forest owners receive compensation for modifying their management behaviour accordingly. Examples of this sort are abundant all across Europe and beyond, e.g. METSO scheme in Finland (Mäntymaa et al., 2009), afforestation subsidies in Denmark (Broch and Vedel, 2010) or Mature forest reserves in Catalonia (Prokofieva and Gorriz, 2013).

Prior studies have highlighted the fact that private forest owners are not only profit-driven (Beach et al., 2005). Yet, many forest policy instruments, especially those which intend to provide economic incentives for behavioural change (e.g. public contractual mechanisms, private and market-based schemes) implicitly presume that FO would compare the costs and the benefits of participating in the instrument with those of not participating, therefore implicitly assuming profit maximization as the most important motivation for forest management. However, the actual participation rates are frequently lower than expected, sometimes even too low to achieve significant outcomes. This might indicate that FOs have other motivations behind their decision to get involved in the policy instruments apart from purely profit-oriented. Previous studies have focused on the following factors as potential determinants of FO decision to participate in policy schemes: (a) active forest management; (b) alignment between FO management motivations and instrument objectives, and (c) socio-demographic characteristics (e.g. forest property characteristics, forest owner knowledge on forestry and economic dependence on forest revenues). We discuss these briefly below.

Previous studies have highlighted the fact that private Forest Owners (FO) are not only profit-driven. However, many forest instruments (public policy interventions and/or market/private tools) have assumed profit expectations as the most important orientation for FO management, hence designing them as economic incentives that promote certain FO behaviour, in terms of changing forest management decisions. However, the actual participation shows lower rates than planned, sometimes too low to achieve significant outcomes. They may have other interests to get involved in the instruments.

Active forest management is seen as a factor potentially increasing FO participation in policy schemes. For example, Juutinen et al (2005) in Mäntymaa et al (2009) mention that in the Nature Trading Values program in Finland participating forest owners were very active in forestry. The differentiation between active forest managers and non-active forest managers is far from straightforward. In their study, Marey-Pérez and Rodríguez-Vicente (2011) discriminate between landowners involved in forestry (whom they call “active”) and those not involved in forestry. This definition however is rather vague, as it does not clearly state what is understood by “involved in forestry”. Bliss & Martin (1989), in turn, equate active management to following the current standards of the forestry profession. The factors affecting active forest management were explored by Domínguez and Shannon (2011), finding that four main factors affect their decisions: economic expectations, the model on how a forest should look like, their moral duty and the perception of risk.

Previous studies have identified that the compatibility of the policy instrument with the FO goals or objectives for their land, as well as the possibility to realise their own particular values regarding forest management might enhance participation (Kline et al., 2000). A related (extensive) strand of literature focuses on clustering forest owners according to their goals, objectives and motivations (e.g. Erickson et al., 2002; Fischer, 2012; Ingemarson et al., 2006).

Previous scholars have identified the compatibility of the policy instrument with existing farming system; this is, with the goals or objectives for the land, as a factor positively affecting landowner's engagement. In this line, Boon et al (2010) already notice the different nature of nature conservation (passive) versus active restoration or amelioration projects may influence the motivation of forest owners to participate in set-aside lands.

The literature also points out to other socio-demographic factors, as follows: household income (Amacher et al., 2003), income derived from the forest (Moon and Cocklin, 2011) or educational level and property size (Kline et al., 2000).

## **Objective**

We aim at analysing the factors that influence private FO engagement in voluntary instruments. Specifically, our first research question asks whether active forest management can explain participation in economic instruments. Based on the previous literature, our hypothesis is that landowners engaged in active management of their forest are more likely to participate in economic incentives dealing with ES provision. The underlying proposition is that active forest owners are more likely informed about the programs and are more acquainted with the bureaucracy linked to them, and hence would participate more.

Our second research question addresses the influence of the instrument design characteristics – specifically the goal of the policy instrument, and the activities promoted by the instrument – on FO enrolment in policy schemes. Our hypothesis is that instruments promoting active forestry, and aiming at enhancing simultaneously various ES would present greater rates of participation than those which seek to limit the landowner's activities and focus on a single ES thereby creating trade-offs with other forest benefits.

The results of this study will provide insights into how to better target FO in view of facilitating and increasing their participation in policy instruments. The novelty of this study lies in the inclusion of the correlation between different dimensions of active forest management (not so explicitly analysed by previous scholars) and the extent of the study which involves a cross-country approach.

## **Methodology**

With surveys across four case studies (Rukka-Kuusamo, Finland; Denmark; France; and Germany) we have explored the degree of FO participation in different schemes and we have analysed factors that could explain such participation using contingency tables. Additionally, qualitative interviews have been conducted in another case study (Catalonia, Spain), which shed light on the possible reasons behind FO participation and their constraints. The data collection was conducted between 2012 and 2013. The qualitative findings jointly with the preliminary results from contingency tables allowed developing hypotheses, which were statistically tested with SPSS, using binary logistic regressions checked for correlation indexes for the used variables.

### **Sample design and instruments under focus**

We did not aim at a representative sample for each case study area, but to gather enough statistical data from different regions in order to discover trends in FO's participation in policy instruments. Table 1 depicts the sample and survey strategy.

### **Brief description of the survey of each CS**

The Finnish case study focused on Rukka-Kuusamo, an area in Lapland with vast forests and an increasing tourism industry related to a ski resort; willingness to change forestry activities for improving recreation were in the focus, jointly with values related to forestry. The German case focused on the benefits private landowners extract from forest cooperatives and values related to forestry, hence only cooperative members were surveyed. The Danish and French case included forest owners from all over the country and included extended questions on participation in policy instruments, forestry activities and FO values. The Spanish case study was located in Catalonia, where forest owners were asked about their participation in policy instruments and their opinions on possible payments for environmental services, focusing on its design features and respondent values.

### **Limitations for the cross-country comparability**

We acknowledge the presence of several challenging limitations stemming from the variety of data collection methods used for this study. First, we find dissimilar samples across countries and very different policy instruments under focus –both in terms of quantity (from one in France to twelve in Denmark), funding organisation (more private in France, all public in Germany and Rukka-Kuusamo, and of both types in Catalonia and Denmark), or ecosystem services in focus (examples here). Surveys were not aiming to capture the whole spectrum of policy instruments, and hence are not exhaustive. Moreover, the German survey did not identify specific policy instruments, but instead named larger subsidy programs with similar objectives and actions across states (*Länder*).

We expect to see larger participation rates in the German and Catalan samples, as respondents have already shown interest in forestry bodies in the first case, and respondents have some close contact with technicians in the second case. We also lack information on landowners' eligibility for specific programmes, and hence we cannot conclude on whether the lack of FO participation stems from their unwillingness or rather inability to participate.

Besides, questions were different in their wording and in their presence. This means, not all the cases gathered information on FO values and attitudes, and when these information were available, they were not collected in a homogeneous manner. Also the importance of instrument design characteristics varied across the surveys. Finally, socio-economic factors have been surveyed in diverse ways, so that only forest size is congruent across case studies. Income and employment variables are very irregular, as per the job categories and the lack of absolute comparability of salaries across countries.

### **Joint database**

In spite of previously mentioned limitations, we built a joint database with the data from the surveys, which gathers up to 8,579 observations. 210 were considered as not valid representing incomplete surveys. For building the database several assumptions were made for the sake of homogenization. Homogeneous concepts served as the basis for defining the variables.

Table 1. Sample description in the case study areas

Case study	Approach	Respondents (% of respondents)	ES focus in instrument	Funding source (nr instruments)
Ruka-Kuusamo (Finland)	Mail survey	471 from Kuusamo municipality	Biodiversity	Conservation of habitats of special importance for biodiversity, preserved by Forest Act / Environmental subsidy for preservation of special habitats / Voluntary conservation contracts under the Metso programme / Nature management projects / Consulting or planning aid for nature management
Germany	Mail survey	209 members of forest cooperatives	Timber, Biodiversity, Recreation	Afforestation aids / Subsidies for forest tending / Subsidies for soil liming / Forest conversion aids / Forest protection aids / Aids for maintenance of forest edge / Conservation by contract / Compensation payments for conservation / Subsidies for building recreation facilities / Forest road construction
France	Mail survey	590 responses of forest owners (15,000 questionnaires sent)	Timber, Other ES	SFM certification
Denmark	Web-based survey	308 responses of forest owners	Timber, Biodiversity, Recreation, Water, Timber + other ES	Subsidy for special management initiatives / Subsidy for replanting after windthrow / Afforestation subsidies / Subsidy for production and sales of Christmas greenery / Practical forest management experiments / Aids for recreation and outdoor facilities / Counselling visit for sustainable management / Subsidies for oak woodlands and coppice / Subsidy for setting aside areas as untouched forest / Single tree contracts for aging and natural decay / Subsidies for sustainable management / Contracts related to groundwater or wetlands
Catalonia (Spain)	Face-to-face qualitative interviews	26 forest owners (100% of respondents)	Biodiversity, Recreation, Timber + Other ES	SFM subsidies / Postfire regeneration subsidies / Forest Defence Groups / SFM certification / Land stewardship / Mature Forest Reserves

We explored at country level the meaning of “active forest management”, which resulted in a very multi-dimensional concept, which includes having conducted forestry works in the property in the past years (showing a usual activity), or the intention to conduct them in the near future, having and/or implementing a forest management plan, being member of an association of forest owners (FOA), or the direct decision-making on the forest (in contrast with delegated management). See table 2 for further details. We built several dummy variables in this respect, as follows: membership in a FOA; presence of a forest management plan; and past active forestry work.

Table 2. Active forest management in the different case studies

Case study	Variables in the survey and best suited indicator (in bold)	Justification
Ruka-Kuusamo (Finland)	<b>Up-to-date forest management plan</b> Last time sold timber in last 5 years <b>Forest operations in last 5 years</b>	Being a member of FOA is mandatory; hence it does not give any additional information.  Having a management plan is optional.
France	Having a forest <b>management plan</b> and/or being <b>member of a FOA</b>  Having done forestry works in the last 5 years	Management plan is costly; hence it shows interest to implement it.  Membership has a cost; and FOA provides information to their members on schemes and may assist them in the application/engagement.
Denmark	Having a <b>forest management plan</b> and/or being <b>member of a FOA</b>  <b>Having done forestry works in the last 5 years</b>  Person making forestry decisions. Person carrying out forestry works	Management plan is costly; hence it shows interest to implement it.  Membership has a cost; and the FOA provides information & assistance on schemes
Catalonia (Spain)	<b>Having conducted forestry works in the last 5-10 years</b>  Being <b>member of a FOA</b> .	Management plan facilitates forestry works permissions and is a pre-requisite for several programs. However, it is fully subsidized and is mandatory for being granted an inheritance tax exemption  Membership has a cost (investment); and FOA provides information to their members on schemes (awareness) and may assist them in the application/engagement.
Germany	<b>Actor conducting forestry works in the past</b>  Person conducting work related to subsidies.	All respondents are cooperative members.  We assume that respondents do not have management plan, as it is not mandatory in Germany, nor facilitates subsidies or harvest permits.  We assume that respondents are active if s/he reports having done forestry works (either itself, through the cooperative or through a forest contractor) in the past.

As representative **socio-economic factor** we included forest size, which has been categorized into 5 classes as follows: micro-owners (0 to 5 ha), small owners (from 5 to 25 ha), medium-size owners (from 25 to 100 ha), big owners (from 100 to 500 ha) and very big owners (larger than 500 ha). Table 3 shows the absolute number for each category per case study. We observe that very small forest owners constitute the largest part of the German and Danish respondents, while for medium-size landowners mean the largest groups for the Rukka-Kuusamo and French case, while big landowners are the most represented group for the Catalan case. This clearly shows that the sampled population does not represent the total population; German associated

landowners tend to be those with smaller areas, and Catalan respondents largely exceed the average property size of 1 ha.

Table 3. Forest size categories in each case study

	Forest size (ha)				
	0 - <5	5 - <25	25 - <100	100 - <500	>500
Rukka-Kuusamo (FI)	63	60	262	85	1
Denmark	104	83	68	30	23
France	132	113	215	101	29
Germany	75	33	46	22	12
Catalonia (ES)	0	0	4	18	4

Finally, the **country** variable has been categorized, being the reference Denmark. Table 4 gather the descriptive characteristics of the sampled forest owners for each case study.

Table 4. Characteristics of forest owner respondents

	Participation in at least 1 instrument	FO Association	Management plan	Past active forestry
Rukka-Kuusamo (FI)	213 (45%)	471 (100%)	227 (48%)	337 (72%)
Denmark	115 (37%)	135 (44%)	63 (20%)	141 (46%)
France	166 (28%)	212 (36%)	264 (45%)	274 (46%)
Germany	173 (83%)	209 (100%)	0 (0%)	194 (93%)
Catalonia (ES)	25 (96%)	19 (73%)	24 (92%)	11 (42%)

**Policy instruments** were classified according to two characteristics: the type of activity they entail and the presence of synergies between the ES promoted and timber production. This is our proxy for measuring alignment between FO values and instrument design. An instrument is activity-enhancing if it promotes forestry interventions (ex. SFM certification, or SFM subsidies), while activity-capping limits forestry works (ex: Contracts for setting aside forest lands, Subsidies for recreational and outdoor facilitation). Some policy instruments require activities that promoting a single Ecosystem Service (ex. payments for biodiversity conservation, contracts for water improvement), while others foster activities that allow a combination of traditional timber production and an ES (ex. subsidies for oak woodlands and coppice, aids for forest conversion).

### Models for participation in policy instruments

In line with the proposed research questions, we have run four different models. First, we analyse the likelihood of participation of a forest owner explained by its active forest management profile, and its socio-economic factor (Equation 1). Next, we test whether there are significant differences among CS, by including a country variable. Our hypothesis is that owners showing more dimensions of active forest management would have larger likelihood of enrolment, as well as larger forest properties.

$$(Eq.1) Odds(Particip) = e^a + e^{b*(mgmt\ plan)} + e^{c*(FOA)} + e^{d*(past\ active\ mgmt)} + e^{e*(size)} (+ e^{f*(CS)}) + \mathcal{E}$$

Then, we test whether the probability of participation increases if the policy instrument design characteristics are specified, this is, the previous model includes the variables of activity-enhancing and the ES promoted (Equation 2). Finally, a last model includes a country variable.



Our hypothesis is that instruments addressing more than a single ES and those promoting activities in the forest would lead to increased odds of engagement.

$$(Eq.2) Odds(Particip) = e^a + e^{b*(mgmt\ plan)} + e^{c*(FOA)} + e^{d*(past\ active\ mgmt)} + e^{e*(size)} + e^{f*(activity-enh)} + e^{g*(multi-ES)} (+ e^{h*(CS)}) + \mathcal{E}$$

## Results and discussion

Table 5 shows the results of the regressions, which indeed prove the hypotheses of participation in policy instruments promoting ES as being explained by the active forestry, and larger forest stands (model 1 and 2). Furthermore, policy instruments that are less restrictive with the previous forestry works, and allowing compatible ES with traditional forestry production show larger odds to engage. The regressions show that when adding instrument design variables (model 3 and 4) the goodness of fit improves, increasing the pseudo-R<sup>2</sup>. All variables appear as being significant. The CS origin of the forest owners appears to have significant differences. Denmark seems to have less participation than Finnish and Catalan respondents; while being a French respondent has lower probability to participate. Interestingly, when including the policy mechanism variable, German respondent move from less probability than the reference case to having a greater likelihood. Still, the large negative constant shows that the majority of landowners have a very little likelihood of participating in policy instruments.

Our hypotheses, then, seem to hold for the data collected across European countries. These variables only partly explain the enrolment of forest owners, as shown by the pseudo-R<sup>2</sup>. These results confirm the previous literature.

## Conclusions

In this exercise we have provided empirical evidence of some factors that affect the odds of private forest owners to engage in voluntary policy instruments. We found that active forestry, socio-economic, and cooperation factors partly explain landowner participation. Likewise, it shows that the alignment of the landowner either with the instrument objectives or its promoted land management measures facilitates the participation. Hence, these results suggest that the design of mechanisms encouraging synergies between current landowners' practices and external ES demands are more likely to attract forest owners than those implying severe management changes for the landowner. On the other hand, this pre-existing alignment may challenge the efficiency of the policy intervention if most of the expected added value would require targeting not aligned landowners; this is, according to our result, those owners who at present are not active in forest management, they own small pieces of forests, or are not member of associations.

Table 5 – Results from the binary logistic regressions

Variable	Model 1			Model 2			Model 3			Model 4		
	B	E.T.	Exp(B)	B	E.T.	Exp(B)	B	E.T.	Exp(B)	B	E.T.	Exp(B)
Constant	-2,436 ***	,153	0,088	-1,962 ***	,250	0,141	-3,650 ***	,177	0,026	-3,009 ***	,268	0,049
management plan	0,339 ***	,069	1,404	0,968 ***	,091	2,632	0,391 ***	,071	1,478	0,971 ***	,092	2,641
FO Association	0,925 ***	,105	2,522	0,538 ***	,135	1,713	1,235 ***	,108	3,439	0,535 ***	,135	1,707
Past active forestry	0,909 ***	,086	2,482	0,551 ***	,096	1,735	0,933 ***	,087	2,542	0,560 ***	,096	1,750
Size: >500 ha												
Size: 0 to <5 ha	-1,014 ***	,130	0,363	-1,401 ***	,141	0,246	-0,856 ***	,135	0,425	-1,502 ***	,147	0,223
Size: 5 to <25 ha	-0,766 ***	,132	0,465	-0,846 ***	,143	0,429	-0,617 ***	,137	0,539	-0,909 ***	,148	0,403
Size: 25 to <100 ha	-0,854 ***	,116	0,426	-0,892 ***	,131	0,410	-0,626 ***	,123	0,535	-0,955 ***	,135	0,385
Size: 100 to <500 ha	-0,419 ***	,124	0,658	-0,536 ***	,135	0,585	-0,258 **	,129	0,772	-0,584 ***	,139	0,558
Activity enhancing Timber + other ES												
							0,669 ***	,078	1,953	1,150 ***	,126	3,158
							0,579 ***	,085	1,784	0,334 ***	,098	1,397
Denmark												
France												
Ruka-Kuusamo (FI)				-0,988 ***	,205	0,372				-1,083 ***	,212	0,339
				0,840 ***	,217	2,315				0,457 **	,223	1,579
Germany				-0,395 *	,203	0,674				0,500 ***	,230	1,648
Catalonia (ES)				1,063 ***	,221	2,896				1,307 ***	,229	3,696
*p<0,1; **p<0,05; ***p<0,01	-2 log likelihood	R <sup>2</sup> Cox & Snell	R <sup>2</sup> Nagelkerke	-2 log likelihood	R <sup>2</sup> Cox & Snell	R <sup>2</sup> Nagelkerke	-2 log likelihood	R <sup>2</sup> Cox & Snell	R <sup>2</sup> Nagelkerke	-2 log likelihood	R <sup>2</sup> Cox & Snell	R <sup>2</sup> Nagelkerke
	6838,973	,071	0,120	6291,694	0,129	,219	6572,978	,100	0,169	6043,264	,155	0,263

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# To own forest or not? Vertical integration in pulp and paper sector

Korhonen, J., Zhang, Y., Toppinen, A.

University of Helsinki, PI 27, 00140 Helsinki, correspondence: jaana.e.korhonen@helsinki.fi

## Abstract

Vertical integration in forest industry refers to firms that provide large portion of wood from their own or controlled forests. Access to resources and competition for cost effective acquisition of industrial raw material are some of the main concerns and advantages for globalized forestry corporations. However, quantitative studies in this topic are still lacking especially at the global scale. This analysis is based on the logistic regression analysis on dichotomous variable whether company owns forest land or not. Data is based on sample of 52 forest companies reported in TOP 100 A Global Forests, Paper & Packaging Industry Survey, and the information provided with regards to corporate forest holdings and corporate financial performance available in corporate sustainability and other reports for year 2012. In results, we see that decision on vertical integration is significantly affected by the firm size, sales and profitability of the company. The influence of location and other relevant factors of firm performance are discussed to the extents that the data allows.

**Keywords:** vertical integration, industrial forest ownership, transaction cost theory, logistic regression

## Introduction

Companies have to take strategic decisions to organize their management, production, sales, and decide the distribution within a business in a way that makes them less vulnerable to outside forces. Access to resources and competition for cost effective acquisition of industrial raw material are some of the main concerns and advantages for globalized forestry corporations. According to Lahntinen and Toppinen (2008), both short-term efforts to increase cost-efficiency and long-term investments in value-added creation are crucial for sustaining competitiveness of forest industry. Consequently, there is an increasing interest on effective management of semi-natural forests and fast-growing plantations to meet demand deriving from increasing global consumption of forest products (e.g. Barua et al. 2014). Companies can secure access to raw material by harvesting from their own forests or they can purchase wood from local or global markets (Lonnsted and Sedjo 2014). Additionally, the businesses of timber investment management organizations (TIMOs) are growing and possibilities of alternative timber growing schemes (e.g. outgrowers) are becoming more popular.

However, the determinants of industrial forest ownership are not well understood especially at global level. Therefore, from the theoretical locus of the resource based view and transaction cost theory, this study explores factors affecting vertical integration to forests in pulp and paper sector.

## Theoretical background

Transaction cost theory explains the firm boundaries with respect to the markets (Coase 1937). The theory can be simplified to explain the firm's decision on input procurement between producing itself (vertical integration) and purchasing from markets. The choice of vertical integration is justified when it minimizes the transactions costs which include e.g. costs of negotiating, monitoring, and enforcing of various contracts. In addition to the decision between "making or buying", an array of intermediate solutions can exist between buying on the market and full integration, including long-term contracts, strategic alliances, and joint ventures (Williamson 1991, Menard 2004).

According to Pfeffer and Salancik (1978), the procurement of external resources is an important tenet of both the strategic and tactical management of a company. They developed resource dependence theory regarding the optimal divisional structure of organizations, recruitment of board members and employees, production strategies, contract structure, external organizational links, and many other aspects of organizational strategy. The resource based view of the firm (RBV) suggests that differences in resource endowments explain the variances between firms' performance (Barney 1991, Peteraf 1993, Wernerfelt 1984). The firms' performance is also linked to managerial decision on the acquisition, integration, and deployment of resources (Sirmon et al. 2007, Sirmon et al. 2011). Firms acquire resources that provide them a competitive advantage in a product market, so these assets can be considered to be strategic (Barney 1986). The resources need to be valuable and rare, and difficult to replicate or substitute (i.e. so called VRIN, see Barney 1991, Peteraf 1993). The resources are thus valuable to the extent that customers value a firm's output (Barney 2001, Prem & Butler 2001, Sirmon et al. 2007).

The strategic importance of forests as an asset is less examined in the scientific literature. In previous research Niquet and O'Kelly (2010) concluded that pulp and paper producers in Sweden and New Zealand increase the degree of vertical integration with increasing fiber specificity, capital intensity, forest ownership concentration and uncertainty. Similar transaction costs factors have been shown to be important determinants of vertical integration among pulp and paper producers by Ohanian (1994) and Wang (2005). The forest ownership concentration and price uncertainty might be especially relevant determinants for vertical integration in areas where timber markets are immature. Conversely, the forest ownership can cause barrier to entry for the competitors (Li and Zhang 2014). This happens when the local wood markets remain thin and the competitors face increased costs in market entry (O'Laughlin and Ellefson 1982, Salop and Scheffman 1983).

## Data and methods

This study focuses on the sample of 52 forest industry firms which are listed on TOP100 Global Forests, Paper & Packaging Industry Survey (PwC, 2013). Corporate operational information concerning categories of demography, business, and forest status (specific indicators see Table 1) in 2012 is collected through browsing PwC report, PPI report, corporate financial report, corporate sustainability report, as well as other public sources (*available on request*). This study focuses forests that are used for productive purposes ignoring the stand specific forest characteristics (species, rotation period etc.). The indicator "Other forests" refers forest areas that are under protection or otherwise outside of production.

Table 1. List of selected corporate operational indicators

Corporate demographic indicators	Business indicators	Forest indicators
Geographical location	EBITDA	Owned forests
Employees	Total sales	Controlled forests
Operating segments	Operating Profitability	Other forests
	Assets	
	Raw material usage and sources	

Descriptive statistics and logistic regression model are used as methodology to explore the corporate vertical integration status. In the logistic regression model, the relationship between corporate vertical integration and corporate financial performance will be examined. Corporate vertical integration is measured by the corporate forest ownership, based on which a dependent dummy variable is established. The variable takes the value of 1 if the firm has the forest ownership and takes the value of 0 if the firm has not. Corporate business indicators (e.g. EBITDA, total sales) and corporate demographic indicator (e.g. employees) are set as independent variables in the model. The probability

of a firm's choice to have the forest ownership ( $P(y_i=1|x_i)=F(x_i'\beta)$ ) could be modeled by the natural logarithm (ln) of odds of choice as follows:

$$\text{logit}(p) = \ln \frac{p}{1-p} \quad (1)$$

where  $p$  is the probability of the choice of having the forest ownership while  $1-p$  is the probability of the choice of no forest ownership. Along with the transformation, the linear function of the model is:

$$\text{logit}(p) = \mathbf{X}\beta + \mu, \quad (2)$$

where  $X$  is the matrix of independent variables,  $\beta$  is the vector of estimated coefficients, and  $\mu$  is the vector of error term.

## Results

### Current state of forest ownership at the firm level

Based on our data, in 2012, 29 out of 52 sampled firms have the forest ownership, 19 firms do not have forest ownership, and 4 firms do not have public information available. Among the firms which have forests ownership, Metsä group from Finland owns and manages the largest amount of forests (11.4 million ha), all of which are located in Finland. However, Metsä group is a cooperative, which gathers together 123 000 private forest owners and therefore it is debatable whether or not it should be included in the sample. Weyerhaeuser from USA has the second largest forests (8.1 million ha), and among which 69% of forests are located in Canada, 30% are located in USA, and 1% are located in Uruguay. The Top 6 forest owner and manager and their forest locations can be seen from Table 2.

Table 2. Top 6 forest owner & manager and their forest locations

Firm	Headquarter	Domestic ownership (%)	Million (ha)	Forests location
Metsä Group	Finland	100	11,4	Finland 100%
Weyerhaeuser	USA	30	8,1	Canada 69% USA 30% Uruguay 1%
Domtar	Canada	100	6,7	N.A.
UPM	Finland	35	4,5	Finland 35% Uruguay 10% US 3% Others (control) 52%
Mondi	South Africa	20	2,3	Russia (control) 80% South Africa 20%
Arauco	Chile	67	2,2	Chile 67% Argentina 16% Brazil 9% Uruguay 8%

The forest ownership status of the Top 5 forest industry firms (listed by PPI, 2012) can be seen from Table 3. International paper mainly has its forest ownership in Brazil, Russia and USA. However, Oji Paper and UPM have relatively diversified global forest operations. Stora Enso (which for example

has separated its forest ownership under the holdings of Bergvik Skog in Sweden and Tornator in Finland) is for example currently the largest land owner in Uruguay. Procter & Gamble does not own any forests at all, maybe because of its concentration on non-forest product segments and within paper segment to B to C business hygiene products that are less forest resource intensive. More analysis will be conducted to study the link between product diversification and corporate forest ownership.

Table 3. Forest ownership status of the TOP 5 forest industry firms

Firm	Headquarter	Forests location	
International Paper	USA	Brazil 61% Russia (controls) 24%	US 15%
Procter & Gamble	USA	no forest ownership	
Oji Paper	Japan	Japan 43% Brazil 16% New Zealand 10% Laos/Thailand 9%	Indonesia 9% China 6% Australia 6% Canada 1%
UPM	Finland	Finland 35% (Tornator) Uruguay 10%	US 3% Others (control) 52%
Stora Enso	Finland	Russia (controls) 49% Brazil 29% China (controls) 10%	Western Europe (controls) 9% Uruguay (controls) 3% others < 1%

### Breakdown of industrial forest ownership at the country level

Table 4 sorted countries by the amount of forests (ha) that owned by sampled forest industry firms in this study. Besides, the amount of controlled forests and forests uses for other purposes by firms are also listed in the table. Sweden has the largest amount of forests that owned by firms, Brazil and USA ranked the second and the third. Finland has the largest amount of controlled forests that can be accessed by firms.

Table 4. Country level forest ownership status by sampled firms

Country	Owned forests (ha)	Controlled forests (ha)	Other (ha)
Sweden	3252000		600000
Brazil	2797273	102300	601697
USA	2783160	232400	
Chile	1704337		157000
South Africa	914218		150000
Finland	887000	11400000	
Uruguay	743683	23752	

### Results from logistic regression model

Table 5 shows means, standard deviations, and the multicollinearity of independent variables as measured by VIF in the model. Assets and operating profitability have a relatively high VIF (4,527 and 5,345, respectively), showing a high multicollinearity risk with other variables (possibly since they are alternative measures for size and profitability of company). Thus, these two indicators are left out when estimating the logistic regression.

Table 5. Means, standard deviation, and the multicollinearity test

	Mean	S.D.	VIF
Employees	19097	241334	2,183
Total Sales (\$million)	5741	5983	1,286
EBITDA	0,121	0,088	1,071
Assets (\$million)	12186	20742	<b>4,527</b>
Operating profitability (\$million)	655	1953	<b>5,345</b>

Z-score transformation is used to standardize values of employees and total sales, since these two variables are measured in different scales. Results in Table 6 demonstrate the relationship between corporate financial performance (indicated by total sales and EBITDA) and the choice of forest ownership. Corporate size (indicated by number of employees) is set as a control variable. Generally, Nagelkerke R Square (0,372) shows a quite good ratio of goodness of fit of the model. In specific, total sales has a positive beta coefficient (2,553) and it is significant at the 0,05 level, which indicates that for a one-unit increase of total sales, the expected change of the choice of P(own forest)/P(don't own forest) is 12,852. Similarly, EBITDA has a positive beta coefficient (11,486) and it is significant at the 0,05 level, which indicates that for a one-unit increase of EBITDA, the expected change of the choice of P(own forest)/p(don't own forest) is 97370,436. Thus, a firm would have a very strong preference of having forest ownership when its total sales and EBITDA are increasing. Employees, as a corporate size control variable, have a negative beta coefficient (-1,799) and it is significant at the 0,05 level as well. It indicates that the increase of employees would lead the preference of no forest ownership rather than owning it. The Hosmer and Lemeshow Test in this model is significant ( $p = 0,02 < 0,05$ ), which indicates that there is a difference between observed and predicted value of variables. This diagnostic test shows there might be some bias in this model, so we will try to modify this problem with larger sample size in the next stage of the study.

Table 6. Logistic regression model

Independent Variables	Model		
	B	Exp(B)	Sig.
Z-total Sales (\$million)	2,553	12,852	0,013 **
EBITDA	11,486	97370,436	0,031 **
Z-Employees	-1,799	0,165	0,027 **
Constant	-0,987	0,373	0,158
Nagelkerke R Square			0,372
Hosmer and Lemeshow Test			0,02

## Discussion

In results, we see that decision on vertical integration is positively affected by the sales and profitability of the company. If companies increase their sales they are likely to choose vertical integration. Similarly, higher profits in the form of slack resources could motivate for forest ownership. Controversially, a large company size in terms of number of employees reduces the probability to own forests. This might be due to the increased transaction costs as the number of employees grows. Thus, corporate strategic decision on vertical integration should bear in mind the balance between profitability and costs at the global level.

Forest ownership has become an important strategic issue in low cost and high productive areas where timber markets are not working efficiently. This is supported by the fact that majority of forest resources owned or controlled by the top 5 companies are located outside of North America or Europe, which have been the “traditional” pulp and paper production regions with established timber



markets. South America has become a hot-spot area of the corporate forest ownership, and forest owners are multinational firms rather than only local firms. Comparatively, South Africa also has large amount of forests owned by firms, however, local firms are dominant.

Hence, in the future, the competition on forest based raw material might be fierce due to reasons of e.g. population growth, forest conservation oriented national policies, and bioenergy policies. Corporate strategic importance of owned or controlled forests, investment locations, and product segments might affect firms' global presents and performance. Thus, for the further study, the relationship between firm's financial performance and corporate forest ownership will be explored by controlling corporate product diversifications and asset locations.

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# Stakeholder Coalitions in the Revision of Finnish Forest Act: Attributes and Power Relations

Teemu Harrinkari<sup>1</sup>, Pia Katila<sup>2</sup>, Heimo Karppinen<sup>3</sup>

<sup>1</sup> Finnish Forest Research Institute, P.O. Box 18, FI-01301 VANTAA, Finland, teemu.harrinkari@metla.fi

<sup>2</sup> Finnish Forest Research Institute, P.O. Box 18, FI-01301 VANTAA, Finland, pia.katila@metla.fi

<sup>3</sup> University of Helsinki, P.O. Box 27, FI-00014 Helsingin Yliopisto, Finland, heimo.karppinen@helsinki.fi

## Abstract

The revised Finnish Forest Act came into effect in the beginning of 2014. The need for revision emerged from the societal changes manifested through the changing objectives of private forest owners, increasing and diversifying demands for forest goods and services and the increasing number of stakeholders, as well the changes in the forest sector operational environment that relate to the globalization of markets and influences of international policies. The objectives of this study are first to identify and describe the different stakeholder coalitions that have been involved in the revision process of the Finnish Forest Act; and second to analyze their relationships and influence in the review process. Advocacy Coalition Framework is used to guide the identification of the stakeholder coalitions and the analysis of the revision process, especially the coalitions' argumentation and relationships. The actors that participated in the revision process are categorized according to the ACF theory as coalitions on the basis of their belief systems and co-operation. The data consist of semi-structured expert interviews and written documentation accumulated during the revision process. According to the results, three coalitions contributed to the revision: a forestry-oriented coalition, an environmentally oriented coalition and an intermediate coalition, mainly consisting of forest administration organizations.

**Keywords:** advocacy coalition framework, legislation, forest policy

# Scenario analysis of the Norwegian forest sector

Hanne K. Sjølie<sup>1</sup>, Greg S. Latta<sup>2</sup> and Birger Solberg<sup>3</sup>

<sup>1</sup> Norwegian University of Life Sciences, Department of Ecology and Natural Resource Management, Box 5003, 1432 Ås, Norway, hanne.sjolie@nmbu.no

<sup>2</sup> Department of Forest Engineering, Resources and Management, Oregon State University, Corvallis, OR 97331, USA, greg.latta@oregonstate.edu

<sup>3</sup> Norwegian University of Life Sciences, Department of Ecology and Natural Resource Management, Box 5003, 1432 Ås, Norway, birger.solberg@nmbu.no

## Abstract

Scenario analysis is a widely applied tool for studying future impacts of changes, interlinkages and cause-effect relationships in a system. Partial equilibrium models of the forest sector may be used to simulate a set of predefined scenarios in order to analyze in a consistent manner how the forest sector develops with the given conditions. For this study, the objective was to analyze how the economy and climate impacts of the Norwegian forest sector develop over the next decades in four alternative scenarios in addition to a business-as-usual scenario. The scenarios were to some extent based on the IPCC AR4 scenarios regarding economic growth and degree of globalization, but concretized to the Norwegian forest sector with prices of timber and wood product, elasticities of demand and supply, policies and international trade. We used the NorFor model to simulate forest management and yields, harvests, processing and consumption of wood products and trade, in addition to greenhouse gas and albedo-induced radiative forcing levels on a regional level in Norway over the next century. The results suggest that even if policies stimulating bioenergy consumption may increase overall harvest levels, they may also lead to increased competition for wood fiber with lower production of some paper grades. Forest carbon sequestration was reduced over the century by these higher harvest levels, albeit partly offset by the substitution effects. The substitution effects were on the other hand highly dependent on the type of bioenergy being produced. Furthermore, the albedo-induced effects had substantial effect on the overall climate impact of increased harvest.

**Keywords:** forest sector, scenario analysis, partial equilibrium models, forest sector models, Norwegian forest sector

# Store or export? An economic evaluation of financial compensation to forest sector after windstorm. The case of Klaus hurricane

Sylvain Caurla<sup>1</sup>, Alexandra Niedzwiedz<sup>2</sup>, Serge Garcia<sup>3</sup>

<sup>1</sup>INRA, UMR 356 Economie Forestière, 14 rue Girardet, 54000 Nancy, France

<sup>2</sup>AgroParisTech, UMR 356 Economie Forestière, 14 rue Girardet, 54000 Nancy, France

<sup>3</sup>INRA, UMR 356 Economie Forestière, 14 rue Girardet, 54000 Nancy, France

## Abstract

We assessed the economic impacts of the financial compensation plan implemented within the forest sector after Klaus hurricane in South-West of France in 2009. We model this plan within a bio-economic partial equilibrium model (FFSM), and we compare it to alternative plans assuming alternative shares between transport and storage subsidies. Five key results stem from our analysis.

First, assuming that windfall wood does not degrade in forest, the compensation plan as it was negotiated favored storage (+25%) compared to other destinations (export and direct consumption) in comparison to a scenario without plan.

Second, the compensation plan as it was negotiated appears to have accelerated windfall supply regardless of its destination. Assuming a positive degradation rate in forest, this acceleration potentially avoids economic losses. We show that, assuming a 5%/year degradation rate in forest, the plan increased the total volume of supplied windfall by 22%.

Third, we show that the plan has been beneficial to the forest sector, whatever the rate of degradation in forest. With a non-degradation assumption, the discounted sum of gains in surplus over the period 2009-2020 matches 9.63 M€ while, with a 5%/year degradation assumption, this discounted sum equals about 44 M€.

Fourth, the impacts of the plan over prices are limited. Outputs show that prices are less sensitive than other variables to the implementation of the plan which can be explained by the relatively low value of price elasticity of supply.

Fifth, FFSSM results show that reallocating part of transport subsidies to storage would (1) limit the fall in price during the first years (-13% in 2010 for a reallocation of 50% of transport subsidies to storage); (2) increase the total gain in surplus (+71% for a reallocation of 50% of transport subsidies to storage); (3) decrease the gain in surplus related to windfall supply activities.

# Critical viewpoints for renewing forest taxation and subsidy schemes in Finland: Results from a Delphi survey

Teppo Hujala<sup>1</sup>, Asta Ervola<sup>1</sup>, Pasi Rikkonen<sup>2</sup>, Heidi Rintamäki<sup>2</sup>, Marika Makkonen<sup>1</sup>, Jussi Uusivuori<sup>1</sup>

<sup>1</sup> Finnish Forest Research Institute (Metla), P.O. Box 18, FI-01301 Vantaa, Finland

<sup>2</sup> MTT Agrifood Research Finland, Economic Research, Helsinki and Mikkeli, Finland

## Abstract

Finnish forest legislation is undergoing an overhaul. A better fit with forest owners' diverse objectives, cost-efficiency, effectiveness and market neutrality are sought by recent reforms of Forest Act and the Act of the Finnish Forestry Centre. An ongoing process aiming to alter the Act on the Financing of Sustainable Forestry has followed those reforms. Simultaneously, the Governmental Report on Forest Policy until 2050 presents some ideas to change the rules of forest taxation toward a more business-oriented model.

These ongoing forest policy processes motivate the present study. We seek for a better, nuanced understanding of new policy instruments aiming to foster sustainable forestry. First, we defined a number of novel policy instruments as alternatives for current policy tools. Second, a policy evaluation framework was developed for a survey to scan respondents' views on the desirability, feasibility and sustainability impacts of the new policy instruments. Third, to serve as the pool of respondents, a large panel of experts and policy stakeholders was defined and invited to respond to a two-phase online survey on the new policy instruments.

The survey employed Delphi technique, an anonymous, interactive expert assessment scheme. The first and second round provided 173 and 74 responses, respectively. For this study, the respondents' basic orientation as well as the argumentation on forest taxation renewal and forestry subsidy renewal was investigated. In particular, the opposing arguments were analyzed to find major obstacles and critical success factors of a particular policy renewal.

The results show that the experts tend to criticize the complexity, poor expected impact or negative sustainability consequences that they connect to the suggested instruments. Various opportunity costs are often mentioned as arguments when opposing a specific policy tool, although the experts may simultaneously support the general aim of the tool. To conclude, policy renewal is a complicated, controversial and delicate process that requires more back-up research, as well as public debate.

**Keywords:** environmental justice, legitimacy, participatory governance, policy evaluation

# Effects of heritage taxation in Danish forestry

Henrik Meilby<sup>1</sup>, Bo Jellesmark Thorsen<sup>2</sup>, Thomas Nord-Larsen<sup>3</sup>, Vivian Kvist Johannsen<sup>4</sup> and Jette Bredahl Jacobsen<sup>5</sup>

<sup>1</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, heme@ifro.ku.dk

<sup>2</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, bjt@ifro.ku.dk

<sup>3</sup> Department of Geosciences and Natural Resource Management, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, tnl@ign.ku.dk

<sup>4</sup> Department of Geosciences and Natural Resource Management, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, vkj@ign.ku.dk

<sup>5</sup> Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, jbj@ifro.ku.dk

## Abstract

In this study we investigate the effects of heritage taxation rules on the economic performance of forestry and, more importantly, on decision making at the forest property level. In Denmark, when a property is handed over from one generation to the next, a heritage tax has to be paid. Apart from this, there is also a tax on the revenue caused by increase in property value during the ownership period. We analyse how the rotation age in model forest properties with given species composition and initial age structure is affected by these two taxes for a planned generational change every 30 years, compared to an unplanned change and a reference model with no tax on heritage or property value increase (or no change of ownership). As the point of departure we apply model properties including 1000 ha of forest and with species compositions representative for different regions in Denmark. This allows us to analyse the basic conditions for private forest owners' management, but also to examine whether and to what extent the taxation causes changes in management that are sub-optimal from a social point of view.

**Keywords:** generational change, private forest properties, rotation age

# How do young Swedish people view forests of future?

Tuomas Nummelin<sup>1,2,3</sup>, [Maria Riala](#)<sup>1,2,3</sup>

<sup>1</sup> EFINORD, SLU- Swedish University of Agricultural Sciences, Faculty of Forest Sciences, Skogsmarksgränd, SE-901 83 Umeå, SWEDEN, [maria.riala@efi.int](mailto:maria.riala@efi.int)

<sup>2</sup> SLU- Swedish University of Agricultural Sciences, Faculty of Forest Sciences, Skogsmarksgränd, SE-901 83 Umeå, SWEDEN

<sup>3</sup> Finnish Forest Research Institute, Jokiniemenkuja 1, Jokiniemenkuja 1, 01301 Vantaa, FINLAND

The preferences young Swedes have for futures of forests are not known as well as those of traditional stakeholder groups, such as forest owners and forest industry. Nevertheless, the preferences of young people matter, because they will be using and managing the forests in the future.

We try to uncover the young people's preferences with a new survey tool, which is based on the idea of a mind map. The tool is designed for studying complex issues, for example the future of forests. The tool should make the response process more interactive and interesting. This should improve the quality of responses and the response rates, which in traditional surveys tend to be low for young people, particularly young men.

Our research project employs a three-pronged approach. We want to know what the young people intend to do in the forest, what they will value in the forest, and what products they will use from the forest. We are interested in seeing if the young people only see the forest in concrete terms, or if they also value immaterial aspects of forests and ecosystem services. The survey design will utilise Swedish and Finnish outdoor recreation studies, modified PEFC criteria and expert views of attributes crucial to biodiversity and important forest products.

The data collection tool has been tested in Sweden and Finland. The data collection will take place in December 2014 in Umeå. A comparable data set will be collected from Finland. Later on, the data will be collected also from young people not studying at university.

The results of the study will give a good basis for future forest policy and management, by describing the preferences of young people in detail.

**Keywords:** future, young people, Sweden, forests

## **Forest Industry & Forest Products Markets**



# Does country of origin matter? Qualitative analysis of young people's choice of wooden household furniture in Germany and Finland

Inkeri Hakala<sup>1</sup>, Anne Toppinen<sup>2</sup>, Minna Autio<sup>1</sup>

<sup>1</sup> Department of Economics and Management, University of Helsinki, Finland

<sup>2</sup> Department of Forest Sciences, University of Helsinki, Finland, corresponding author, email: anne.toppinen@helsinki.fi

## Abstract

Previous studies on wooden furniture have examined the effect of tangible and intangible product attributes and the role of forest certification on the consumer's furniture choice. However, in the comparative European context there is a research gap in studying furniture consumption from the viewpoint of young consumers. This paper examines young consumers' experiences of wooden furniture in Germany and Finland. Qualitative data was gathered in 2013 with ethnographic field work and 22 guided interviews conducted among consumers between 23-34 years of age. The data was content analysed using thematisation. Based on the results appearance, price and quality are found to be three main attributes in both countries, followed by functionality and ecological aspects. From the marketing point of view, (domestic) country of origin was emphasized as an essential attribute among young Finnish consumers, whereas for German consumers domestic origin did not play a role. However, in both countries, the use of tropical wood species was criticized. Although the immediate furniture choices of young consumers may be dictated by budgetary reason and target towards low-end mass-produced market, these individuals may have high respect for handicraft skills associated with traditional wooden furniture and the value of embedded national heritage. In addition, our interviewees expressed a degree of cynicism towards current eco-labels in use, suggesting a need to deepen their information content and accountability in terms of communicating product sustainability. Further research is called for to analyze, among other things, the symbolic value of Ikea for the young generation European consumers.

**Keywords:** wooden furniture, young consumers, consumer taste, sustainability

## Introduction and aim

Consumers value economic, functional, aesthetic, environmental and ethical aspects when they choose furniture and decorate their homes (e.g. Fuentes 2011, Hoyer and Stokburger-Sauer 2012). Consequently, home and decorating styles reflect consumers' taste, to which symbolic and communicative values are important. As Knorr Cetina (1997, p. 11) has argued, products are not valued for their intrinsic properties, but rather for what they buy – status, relationships and other objects. Fuentes (2011) has pointed out that even though homes and their decoration are private and physically accessible only for selected people, they are often made more public through spoken description or pictures. Ilmonen (2004) has stressed that the use value of goods cannot be reduced only to their symbolic aspects. Also the functionality and productivity of goods are important. For example, what purpose the furniture is for, and what kind of material is suitable and durable in use. Furthermore, objects can play an active role in our relationship to other people (Ilmonen 2004). Goods, such as furniture, do not speak back unlike humans and yet, they may attract our attention and even become objects of passionate care and great attraction (McCracken 1988, Knorr Cetina 1997, Ilmonen 2004).

However, how consumers of today – or especially the young ones representing the future consumption class – perceive the role of environmental aspects in furniture consumption is not well understood (see, however, Rämö et al. 2012). Does country of origin matter to young European

consumers, who today have often been internationalized through travel from their early years? Furthermore, are there some cross-cultural differences in the comparative European context?

To contribute to this literature, this paper aims at examining young consumers' experiences in case of wooden furniture markets in Germany and Finland. In particular, we will elaborate the importance of country of origin and source of wood raw material for the consumption experience of target sample.

## Literature review and conceptual background

According to Baudrillard (1968), for consumers, functionality in furniture constitutes of two aspects: design and atmosphere. In addition to individuality in tastes and preferences, identity and lifestyle also play a role via shared cultural meanings of "what constitutes a good taste", and these standards are being created and replicated via interaction and education (Hoyer and Stokburger-Sauer 2011, 171).

Consumer taste plays a critical role in judgment and decision-making of hedonic products (e.g. Holbrook & Hirschman 1982, Hoyer & Stokburger-Sauer 2012). *Young consumers* are often seen as spending hedonists, who are socialized in the contemporary society through consumption (Miles 2000). However, young people are studying, working in a low-income jobs or being unemployed, and thus, their financial position is usually weaker than full-time workers. For that reason, young people cannot spend generously on expensive items, such as furniture – if it is not their hobby that they are willing to invest in (for example an expensive design chair). According to many studies young people base their consumption decisions on a combination of the various criteria (e.g. Wilska 2003, Autio et al. 2009), such as being rational (self-control), economical (price, saving), hedonist (pleasures, wasting) and responsible (green and ethical choices). The obstacle to green consumption in the life of young people is the premium prices of organic and environmentally friendly products (Autio et al. 2009; p. 46). In the furniture market, young people could thus favor second hand, inherited, and recycled furniture due to budgetary as well as environmental and ethical reason.

When Rämö et al. (2012) studied young Finnish adults consuming wood based products, they found two consumer categories. Majority were those driven by environmental and societal values and minority those who reasoned their purchases rather by price and trendiness. According to their study the consumers in the age group between 20-25-years were more likely to be selfish and stress the economical values over the responsible environmental and societal reasons. This was seen to be due to the lower budget in the use of this age group consisting of mostly students.

Besides taste, economical, ecological and ethical issues also safety and material aspects have been topical theme in furniture research (e.g., Pakarinen 1999) and overall home decorating (Kozak et al. 2004). For example, consumers consider wood as a high quality, expensive, aesthetic, and ecologically sound material, especially when used in furniture (e.g. Jaskari 2011). *Ethical consumption*, which also reflects the symbolic value (caring consumer), has been rising in the past few decades in the Western world, which also shows in the volume of research on these issues (Newholm and Shaw 2007, p. 254). In a recent study on Nordic furniture designers, the integration of ecological criteria influences both the perspectives on material and process optimization and the end use of wooden furniture as well as the recycling of these products (Lähtinen et al. 2014). For Finnish consumers the main selection criteria in purchasing furniture have been found to be visual appearance, functionality, and high quality (Valtonen 2008).

Regarding furniture market, significant attributes to consumers can be, e.g., price, visual appearance, functionality and durability, but also the origin of material as well as its safety aspects, procurement policies and sustainability of manufacturing can be influential. According to Peterson and Jolibert (1995), country of origin may significantly affect the perceived quality and reliability of a product during the time of purchase. In case of products with Scandinavian origin, according to Roncha (2008), a key brand asset is the combination of design and responsible manufacturing supplemented with affordability of products, which has resulted in recognition of products in the global markets (see

also Lahntinen et al. 2014). Ikea is arguably the best-known brand for furniture associated with Scandinavian origin despite the fact that a great body of the brand's wooden products are merely designed in Sweden and manufactured via outsourcing elsewhere in lower cost countries.

Previous studies on wooden furniture have examined the effect of tangible and intangible product attributes – and particularly from environmental perspective the role of forest certification – on the consumer's furniture choice, and have in general indicated superiority of wood as a material (e.g. Pakarinen 1999; Bigsby and Ozanne 2002, Jaskari 2009; 2011). The role of the different wood species has been also studied in e.g. Scholz and Decker (2007). Regarding the choice of sustainable wooden products, product safety aspects have been emphasized among Finnish consumers (Toppinen et al. 2013). Paradoxically, furniture industry in traditional production regions of North America and Northern Europe has been severely suffering from low profitability and lack of demand in domestic markets due to emerging low-cost competition (e.g. Lihra et al. 2012).

Ilmonen (1993, p. 203) has used a model to describe the consumer-good relation. It identifies four different dimensions of consumption and actor positions of consumer. A good has value in exchange, but it also is a symbolic channel in communication between two realities: in markets and in the consumers' experiential world. The first dimension is **economic** and related to price of product. In this the consumer has a customer role. In the second dimension product is regarded through its **functionality**, here consumer consumes its various properties and transforms the product eventually to waste. The good's third dimension of being **symbolic** stems from the work by Baudrillard (1970), in which social relationships and communication are essential, and status and brand aspects play a role. Finally, as a **productivity** ('prosumer') dimension, consumer uses products and services to essentially create something new (also Ilmonen 2004). A second hand or antique furniture can include all of these aspects; it is exchanged in the market, thereafter perhaps maintained or modified, and used by the owner both in its physical purpose and in more abstract way to communicate for example the status (eg. McCracken 1988) or taste of the consumer.

## Data and analysis

Qualitative data used in this study was gathered in 2013. It consists of ethnographic fieldwork done in furniture stores and fairs and 22 guided interviews conducted among 23-34 years-old consumers in Finland and Germany. The observation material based on the fieldwork consists of written notes and photographs, and has been used as background information to draw the cultural context of the study.

The main focus in this paper is on the interview material. The themes of the guided interviews were (i) furniture in the interviewees' own possession, (ii) furniture purchase reasoning, (iii) environmental and origin labelling, (iv) safety of the furniture, (v) domestic vs. foreign products and materials, (vi) Finnish furniture design and furniture design in general. A guided interview was chosen to allow the informants to explain and discuss the topics broadly and without pre-set hypotheses. The transcribed interviews were analysed using thematic content analysis. The interview themes lead the analysis process, although some unexpected themes, such as the role of both the Ikea brand and the used furniture, also rose from the interviews and were taken to closer analysis.

The results give an understanding of which way consumers discuss about their furniture choices. The findings should, however, be treated with caution since the data was collected in two large cities in Germany and Finland, and therefore not representing the German and Finnish consumers. Also the interviewed were all young adults, who had either graduated with or were at the time studying for a higher education degree, so the results are likely to be weighted towards youth representing higher education background.

## Results

Consumers were asked to tell in their own words which factors affect their furniture purchases. In Table 1, different aspects that were mentioned in interviews are classified under key themes. The

themes were found to be fairly similar between countries; price and quality as well as the appearance and functionality were considered to be key issues. There were, however, also some differences, such as higher recognition of environmental friendliness in Germany. Therefore, we will focus the role of raw material origin and question “what constitutes environmental friendliness” in more detail.

Table 1. Consumer argumentation for furniture purchase (in order of importance)

<b>Germany</b>	<b>Finland</b>
<b>Price/available budget</b> Limited budget as student; readiness to save money; careful consideration if more expensive product	<b>Appearance</b> Attractive, catches eye; image when entering the store
<b>Appearance</b> Compatibility with existing furniture; naturalness; traditional appearance – history in furniture, colour, size, inspiration from books	<b>Price/available budget</b> Limited budget as student; related to quality
<b>Functionality</b> A clear need to purchase; fits well to intended use	<b>Quality</b> Durability; longevity; recyclability and second use; quality materials;
<b>Quality</b> Durability, solid wood as material	<b>Functionality</b> Fits well to intended use; comfortable
<b>Origin</b> How and in which country manufactured?	<b>Environmental friendliness</b> (Occasional remarks)
<b>Environmental friendliness</b> Use of wood; eco-label	

As results in Table 2 show, from the marketing point of view, (domestic) country of origin was emphasized as an essential attribute among young Finnish consumers, whereas for German consumers domestic origin did not play an important role. Environmental friendliness of product or country-of-origin were not often spontaneously brought up in interviews when talking about decision-making related to purchasing household furniture. One female from Germany raised the issue of retail stores lacking information on environmental aspect. However, when the topic of “environment” was introduced to interviewees, they found it relevant and this produced a lot of speech. For example, interviewed young consumers commonly discussed their role as an ethical consumer and related idealism.

Table 2. Summary of main findings regarding environmental friendliness, eco-labels and origin of the wood

	Environment and origin labels	Domestic origin
German consumers	<ul style="list-style-type: none"> <li>▪ <b>Rainforest wood</b></li> <li>▪ Avoidance of origin information for budgetary reasons</li> <li>▪ Unable to name specific labels</li> <li>▪ <b>Critique towards labels</b></li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Not relevant</b></li> <li>▪ Less transportation</li> <li>▪ Trust in German forestry practices and the legal system guiding it</li> <li>▪ German wood species good</li> </ul>
Finnish consumers	<ul style="list-style-type: none"> <li>▪ <b>Made in Finland and Nordic labels</b></li> <li>▪ Swan label (Nordic ecolabel)</li> <li>▪ Rainforest wood mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>The most important assurer of product quality</b></li> <li>▪ Expensive</li> <li>▪ Long-standing traditions in Finnish wood industry</li> </ul>

The consumers can be roughly divided into following categories according to their way of stating their standpoint on ecological and country-of-origin related issues:

- i. Does not talk about environmental issues or manufacturing conditions
- ii. Mentions them, but tells that they don't influence own choices
- iii. Mentions, but because of higher prices avoids only rain forest wood
- iv. Tells that has already made ecologically / environmentally aware purchase(s)
- v. Does not buy furniture in stores at all

Only a few of all the interviewed consumers (iv) described any actual furniture purchase they had made with careful consideration of environmental and origin aspects. In these few cases, the question was about buying a specific piece of furniture, such as outdoor set or kitchen table. There was often a conflict with individual action and ideals, which they willingly admitted. In both countries, the use of tropical wood species was criticized. Especially German consumers voiced (iii) absolute criticism against not buying furniture made of tropical wood. However, otherwise they acknowledged that due to higher prices, the choice of sustainable products had to be compromised. For example one German male interviewee was frustrated of having to compromise idealistic world views at this age until he can afford to choose more responsible furniture at later stage of life span:

*"[W]hen you still have your ideals you don't have the money to follow up your own ideals, because you're still a student."* (Male 30b Ger)

Instead, from ethical perspective, the Finnish consumers mentioned employee conditions and illegal loggings of wood, but more often they (ii) claimed that they did not think about the issue when purchasing furniture. Despite several questions about environment and origin of wood, some Finnish consumers (i) neglect ecological aspects and production conditions. They perceived origin to strongly associate with "Made in Finland"-concept, that they viewed through two main aspects: product quality and design.

Among the German consumers furniture was also made by hand. Some of the interviewees (v) explained building their own furniture or purchasing it used. These people did mention the ecological and origin issues of the furniture available in the market, and that they did not buy new furniture. In addition, consumers in both countries expressed a degree of cynicism towards current eco-labels in use, suggesting a need to deepen their information content and accountability, as the following two quotes illustrate:

*“So the thing I’d trust would be the sort of made in Finland and then I would trust on hand-made. Maybe if it was manufactured, say, in the Nordic countries [...] I would count on these very simple markings. But the global systems, I wouldn’t trust them. In any case, it wouldn’t be a high priority for me.”* (Female 27b Fin).

*“... I think the same [that] goes for all organic labels is that there’s so much white washing or green washing in that kind of sense that you never really know where it’s going. (...) And I wouldn’t trust Ikea if they say that’s green, I don’t trust H&M when they say that it’s organic.”* (Male 30c Ger)

The interviews showed furniture retail chain Ikea to have a special role in consumers’ furniture discourse in both Finland and Germany. The consumers used the company as an example when they talked about the furniture they own and their previous and future purchases. Also they tended to use Ikea as a universal example on more abstract subjects such as environmental and safety issues. The talk about Ikea’s furniture offers a useful tool to decode the meanings and expectations consumers have concerning furniture also on more general level. For example the consumers discussed frequently negative experiences concerning the Ikea-furniture. It was thought to lack the durability and uniqueness that the consumers suggested they were looking for. There was also the tendency amongst them to use price as a legitimating reason, when explaining why they would still purchase furniture in Ikea – even after self-experienced disappointments with the previous ones had made them aware of the low quality trade off. Ikea-talk was so frequent and spontaneously brought up in our data that we could see indications that young generation European consumers see Ikea for furniture as being close to what “Hoover” is for vacuum cleaners or Xerox for copy machines.

Furthermore, the results interestingly underlined that young consumers’ may have high respect for handicraft skills associated with traditional wooden furniture and the value of embedded national heritage although their immediate furniture choices may be dictated by budgetary reason to target towards low-end mass-produced market.

*“I think people, our generation, (...) we value things that have a kind of story.”* (Male 30c Ger)  
*“From a flea market in Hämeenlinna a wooden table which I’ve sanded myself. [...] it has an immediate emotional value, when you’ve worked on it yourself.”* (Female 27a Fin)

According to results in both countries consumers gave special value to the used furniture, especially the ones they had inherited, repaired or built themselves (see also Ilmonen 2004). These pieces of furniture raise consumers’ affection, because they have a personal bond to them, giving meaning beyond their functional values. Also the used furniture was valued for its time lasting, solid wooden structure, which was juxtaposed with the non-solid materials typically used in the modern day low-budget alternatives. Furthermore, it appears that the young Finnish and German adults gain cultural understanding of the sustainability potential of the wooden furniture (also Kozak et al. 2004, Jaskari 1999), particularly through the experiences they have with inherited or second hand furniture.

## **Discussion**

It seems that Finnish young consumers of this study tend to relate environmental and origin issues to the domestic country of origin. In comparison the German consumers are generally more concerned about the issue of rain forest wood or long shipping of the material or products. Both Finns and Germans were trustful of the domestic and European regulations, and ready to believe that what is offered in the Finnish and German market, can also be regarded as fairly safe to the consumer.

Interviewed consumers were aware of and uncomfortable with the environmental compromise they were making when buying cheap and short-lived furniture. Both the Finnish and German consumers tended to explain their purchase choices using thrift speech typical of both consumer cultures (Autio et al. 2009, Walsh et al. 2001). According to some, the making of conscious purchase choices were seen time demanding and yet difficult to be certain about. Recycled and inherited furniture appeared as a safe ground for young adults struggling to meet their contradictory economical and

environmentally sound ideals. In placing the results to four conceptual dimensions by Ilmonen (2004), the raw material and origin represents symbolic meaning of furniture while recycling and use of second hand furniture is about productivity dimension in a process to create something new. In contrast, discussion on Ikea and lack of financial resources to buy solid wood or design furniture, is related to economic dimension via allowable budget and young consumers' price sensitiveness.

The young adults in this study describe a continuum of the different life phases, where they position themselves often in a period before responsible or long-lasting consumption choices. Similar feature was found by Rämö et al. (2012), which concluded that the Finnish consumers in the age group between 20-25-year old predominantly argued their wood product purchases to be driven by price and trendiness, instead of environmental and societal reasons. Also in this study the young adults brought up the importance of limited budget and their ongoing life phase in which the responsible purchase choices were not current.

The studied consumers have already experienced their 'good and bad' furniture choices when they have furnished their first own home. Through their experiences with inherited, second hand furniture, and Ikea they are gaining awareness on what is culturally approved and what is the taste of their own, when talking about furniture and wood material. They indicate a generation that has a globally shared 'Ikea-language' to express their identity when discussing their furniture values in their lives and creating their home (see also Björkvall 2009). Therefore, in the future research, we see interesting opportunities in analyzing in more depth the symbolic value of Ikea for the young consumers and for example in comparison to consumers in the next life-phases (between 30-45 years and up).

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# Market analysis of harvesting services engaged by private forest owners in Sweden

Dianne Staal Wästerlund<sup>1</sup>, Thomas Kronholm<sup>2</sup>

<sup>1</sup>Department of Forest Resource Management, SLU, 90183 Umeå, Sweden, dianne.wasterlund@slu.se

<sup>2</sup>Department of Forest Resource Management, SLU, 90183 Umeå, Sweden, thomas.kronholm@slu.se

## Abstract

The forest industry in several Nordic countries is heavily dependent on the timber supply of the non-industrial private forest owners. This study focused on the behaviour of forest owners on the timber market when they chose a timber procurement organization. The study was made with a survey among forest owners that during the year 2011 notified the Swedish Forest Agency that a final felling would be performed on their forest property by way of their timber procurer. The survey was answered by 418 forest owners (79% male and 21% female). It was found that there was no difference in age distribution between the forest owners in the sample compared to the total age distribution of forest owners in Sweden. Harvesting was more common on large properties. Half of the forest owners had made timber deals with other timber procurement organizations before. Earlier research suggested that forest owners do not analyse the market, but this study suggest that a change may have occurred. Although a majority of the timber deals were made on the initiative of the forest owner, 17.2% of the deals were based on a tender of the forest owner and this concerned mainly large timber deals. One in four of the forest owners experienced problems, mainly related to how the harvesting operation was performed. Female forest owners, absentee owners and share owners experienced significantly more problems. The results indicate that the forest industry may need to intensify their efforts to learn and understand forest owners better, especially with the new generation forest owners, to maintain their level of timber procurement from the private forest sector.

**Keywords:** timber procurement, customer relations, harvesting services, loyalty

## Introduction

In several Nordic countries, the forest industry is dependent on the supply of timber from non-industrial private forest owners (NIPF owners). In Sweden 59.6% of the gross fellings were harvested on forest land belonging to NIPF owners during the period 2010 – 2012. In Finland 78.2% of the timber harvested came from private owned forest land (Finnish Forest Research Institute 2012).

A lot of research has therefore been made on factors affecting the forest owners' willingness to perform a harvesting operation and sell timber to the industry. The timber price has been identified as the most important factor influencing the willingness to deliver wood to the industry but ownership characteristics as well as forest characteristics have also been identified as influencing variables (Favada et al. 2009). According to Kuuluvainen and Salo (1991) the willingness to harvest decreases as the age of the forest owner increases. Older forest owners have according to Kuuluvainen and Salo (1991) less loans that need repayment and require therefore less income which may according to them at least partly explain the difference in behavior between older and younger forest owners. Conway et al. (2003) found that debt was a strong motivator for harvesting. Another explanation for the age given by Törnqvist (1995) and Lönnstedt (1997) is the bequest motive or the planning for intergenerational transfer of the property to the next generation. According to this perspective, the older generation would like to save older stands for harvesting for the next generation. According to Conway et al. (2003) absentee forest owners are less likely to harvest than landowners living on their property and according to Lidestav and Berg Lejon (2012) female forest owners are less inclined to perform a harvesting operation than male forest owners. Activity levels at joint owned properties were also lower than on single-owned properties (Lidestav and Berg Lejon 2012). As the structural change

in the Swedish private forest sector shows that the average age of the forest owners, the share of absentee owners, the share of joint-owned properties, as well as the share of female forest owners are all increasing it seems necessary for the forest industry to increase its efforts to secure its raw material supply in the future.

Although forest owners are suppliers of timber to the industry, they can also be regarded as customers of harvesting services as they often sell their timber on root and let the timber procuring organization perform the harvesting operation. The large majority of the NIPF owners do not perform the harvesting operation themselves anymore. According to the Swedish Forest Agency (2013) the volume that forest owners harvested in final fellings themselves in 2012 was only 3% and in thinnings 16%. The decision to supply is therefore in most cases closely connected with a choice of timber procurement organization and subsequent customer expectations on the quality of the services provided. These aspects have so far only limited been studied. The timber market in Sweden consist of a number of different types of organizations that procure timber from NIPF owners and supply harvesting services, such as: a) large (multi)-national forest companies, owning several forest industries in the country as well as forest resources, which buy timber from private forest owners to complement the timber supply to their industry coming from their own resources, b) forest industries that totally rely on procuring timber from private forest owners and have their own timber procurement organization, c) forest owners' associations, cooperative organizations owned by the forest owners themselves which sell round wood of their members to forest industries but a majority also own industries, d) forest management organizations that provide total management of the forest property, including administrative services not only to private forest owners but also to public forest owners such as municipalities, and e) forest service companies that provide all kind of services to the forest owner and trade the timber that is produced to other forest companies. The differences in business objectives of these organizations may affect the prerequisites of the potential timber deal they can make with the forest owners. For forest industries for example it is important to limit the costs of the timber and therefore like to keep the price down. Quite the reverse is the objective of the forest owners associations who want to pay well for the timber delivered by its members. How forest owners behave on the timber market when the decision to sell their timber has so far not been evaluated other than by the companies themselves. Neither has it been evaluated if the forest owners' characteristics influence their behavior on the timber market, how versatile their behavior is and how satisfied they are with the service provided.

In interviews made approximately 20 years ago, forest owners said that they most often do not do market research before contacting a timber procurement organization (Lönnstedt 1997). They often contact the timber procurer they have dealt with before unless they were dissatisfied with the previous services of the organization (Lönnstedt 1997). But the structural changes in the forest owner population and the strong competition for timber among the forest industries may have changed this situation. As the knowledge about forest owner behavior on the timber market is limited, the objective of this study was to describe and evaluate the present market for harvesting services in Sweden and to analyze the forest owners' behavior when choosing a timber procurement organization.

## **Material and methods**

### **Principal of selection**

When planning a final felling on an area larger than 0.5 ha, all forest owners need to notify the Swedish Forest Agency at least 6 weeks in advance. If the final felling is to be performed by the timber procurer it is customary that they submit this notification on behalf of the forest owner. For this study, the Swedish Forest Agency was asked to take a random sample among the notifications submitted by agents to private forest owners during the year 2011. The total number of notifications submitted to the Agency in 2011 was 33714. The Agency took a sample of 1025 cases and after removing cases that were duplicates, cases that did not concern private forest owners' land, cases with incomplete addresses on the forest owner and cases where the forest property belonged to an estate of a deceased person, the final sample used in this study was 973 cases. The information received from

the Swedish Forest Agency was personal information of the contact person to the forest property, the property id, the name and address of the timber procurer organization and the size of the property (if this was available in the data base of the Agency).

### Questionnaire

A questionnaire was constructed and sent to the 973 forest owners. The complete questionnaire consisted of 60 questions divided over 5 sections. Section 1 and 2 consisted of questions concerning service quality and will be reported on in another article. Section 3 concerned questions about the contacts the forest owner had with the timber procuring organization such as how often they had sold timber to this timber procurer, who made the first contact to initiate the timber deal, how often they had been in contact, if the forest owner experienced any problems during the process and the size of the timber deal. In section 4 the forest owner was asked questions about his/her relations towards the timber procurement organization, and in section 5 further background information about the forest owner was asked such as the age, gender, education and ownership constellation. As the purpose of this article is mainly descriptive, the answers given in section 3 and 5 were used for this article. The questionnaire was sent by mail in November 2012. After one reminder sent two weeks after the first dispatch in total 418 answers were received, which gives a response rate of 43%. The drop-out analysis showed that the average age of those that responded was slightly higher than those that did not respond (60.8 respectively 58.2 years old) and that men had responded more frequently than women (45% respectively 36%). No difference was found in the distribution over the property size classes between forest owners that had answered compared to those that had not answered. There was a tendency ( $p=0.08$ ) that forest owners living in Götaland and Norra Norrland had answered more frequently than forest owners living in Svealand and Södra Norrland.

### Analysis

To determine statistical differences the chi-square test was used on the frequency tables.

### Results

Of the 973 final felling cases, 79% were conducted on land where the contact forest owner was a man and 21% were conducted on land where the contact forest owner was a woman. The average age of the forest owners that performed a final felling was 59.3 years old. Figure 1 shows that the age distribution of the sample was very similar to the age distribution of the Swedish private forest owners in total (Swedish Forest Agency 2013). In the sample 21.5% of the forest owners were 70 years old or older.

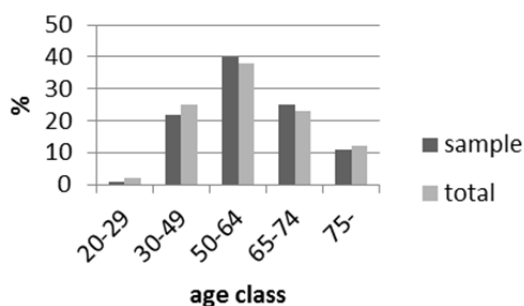


Figure 1. The age distribution of the sample compared to the age distribution of the total population of private forest owners (Swedish Forest Agency 2013)

Of the 973 properties that were subjected to a final felling, information about the size of the property was available for only 865. The average size of those 865 properties was 136.6 ha. No statistical differences were found between the size of the female forest owners and the size of the male forest owners in the sample. Figure 2 shows that the large properties (51 ha and more) are more frequently represented in the sample than the small properties (less than 20 ha) when comparing the sample with the distribution over all forest properties in Sweden (Swedish Forest Agency 2013). Figure 3 is based

on the answers received on the questionnaire and reveals that the intensity of the harvesting operation expressed in m<sup>3</sup> is larger on the large properties compared to the small properties (p<0.000). Figure 4 shows that single owners on large properties are relatively more active than share owners.

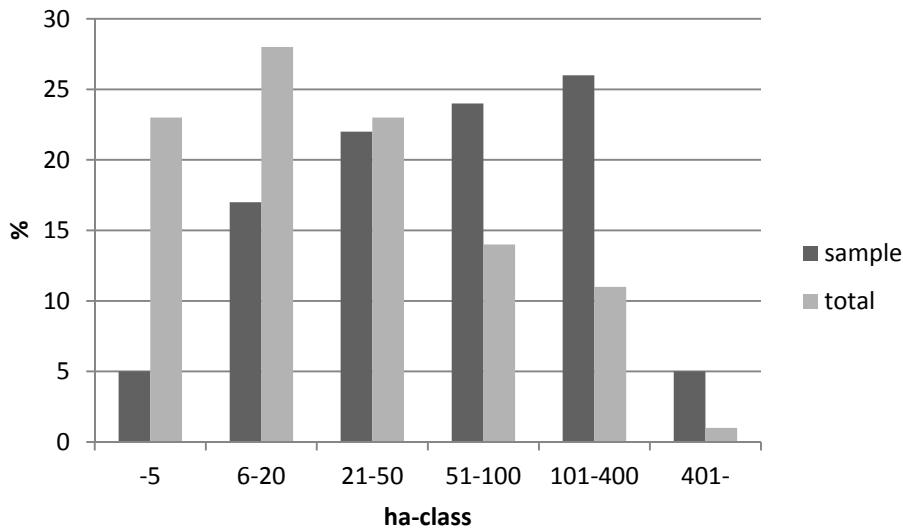


Figure 2. The distribution of the properties according to size in the sample (865) compared to all forest properties owned by private forest owners (Swedish Forest Agency 2013).

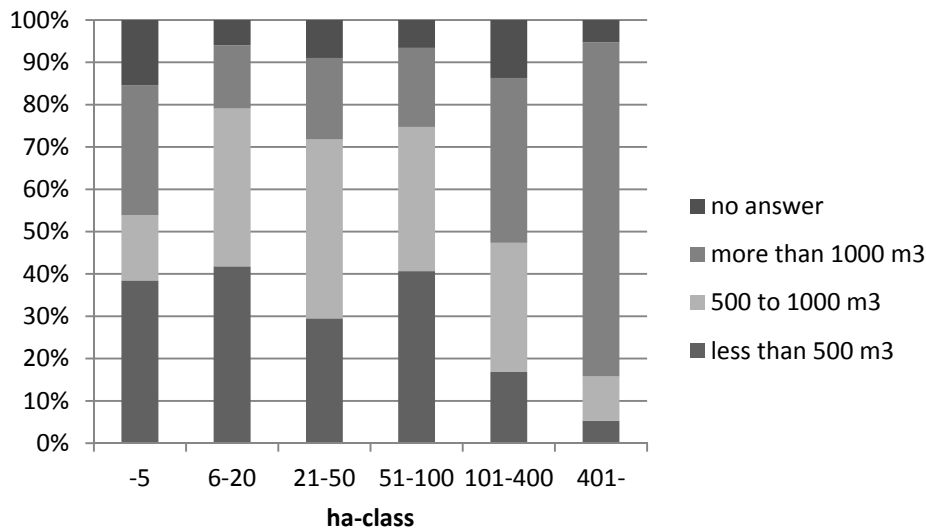


Figure 3. The harvesting intensity on the properties according to property size.

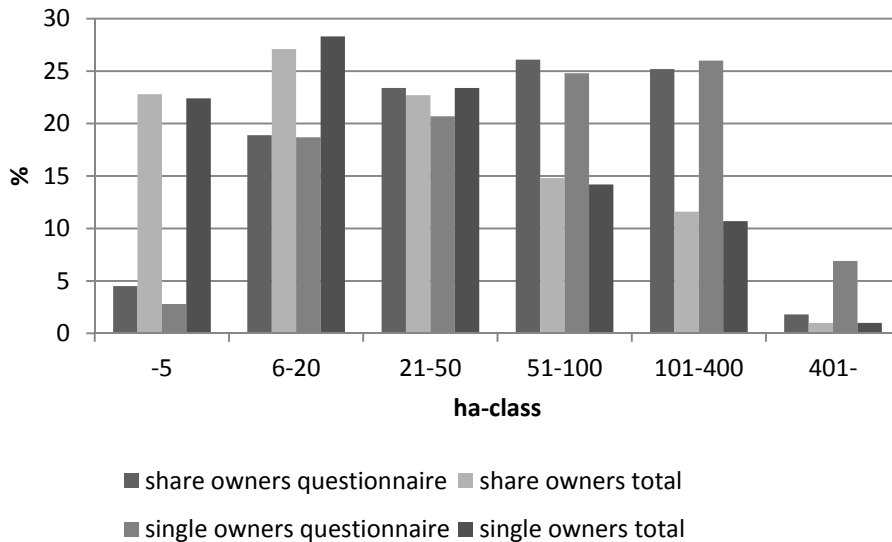


Figure 4. Comparison between the proportion of single and share owners that have been harvesting and in the total population of forest owners in Sweden according to the size of the property (Swedish Forest Agency 2013).

A majority of the forest owners that answered the questionnaire were single owners to the forest property (59.8%). There were no significant gender or age differences in ownership form. Nor were there any significant difference found between single owners and share owners in the size of the properties they owned. 75% of the forest owners had owned the property more than 10 years and 78% of the forest owners were living in the municipality where the property was situated. Although not significant, there was a tendency that more female forest owners than male forest owners were absentee owners ( $p=0.1$ ). The female forest owners were significantly higher educated than the male forest owners ( $p=0.0001$ ) while it was significantly more frequent among male forest owners to have a loan on their property ( $p=0.0009$ ) compared to female forest owners. It was also found that the younger forest owners (less than 50 years old) were significantly higher educated than the older forest owners ( $p < 0.000$ ) and that the younger forest owners more frequently had a loan on the forest property ( $p < 0.000$ ). Forest owners to larger properties (51 ha or larger) were significantly more frequent a member of a forest owner association ( $p=0.0067$ ) than forest owners with properties of 50 ha or smaller.

It was found that 91% of the forest owners that made a timber deal with a forest owner association also were members. However, only 62% of forest owners that were members of a forest owners' association had made their timber deal with a forest owners' association. Half of the forest owners (50%) had made previous deals with other timber procurement organizations than the one they were dealing with in 2011. No significant differences could be found between the forest owners that had changed between timber procurement organization and those that had not changed based on their personal characteristics. But forest owners that made their deal with a forest owners' association or a forest management organization were significantly less inclined to change between timber procurement organization ( $p < 0.000$ ). In table 2, the reasons that were mentioned for changing are compiled. The most common reason for changing was economical as the price offered by another company had been better (17% of those who changed). Dissatisfaction with a former timber procurement organization was the reason for 11% of those who changed while 10% found something offered by the other timber procurement organization that they esteemed and were devoid of by the former company. This could be good relation with the timber procurer, service level, or vague descriptions such as better feeling. 3% acted on an opportunity like a planned harvesting in the area by another company, while 4% simply wanted to test another company. Most forest owners that had changed did however not give a reason.

Table 2. Reason given for changing to another timber procurement organization

<b>Economic reasons (better payment)</b>	35 (17%)
<b>Organizational reasons (changes in the timber procurement organizations)</b>	11 (5%)
<b>Dissatisfaction</b>	23 (11%)
<b>Offer service that suits better</b>	22 (10%)
<b>Opportunity</b>	7 (3%)
<b>Wanted to test another company</b>	9 (4%)
<b>Other / Do not know</b>	7 (3%)

For only 2% of the forest owners the timber deal in 2011 had been the first one and 42.3% had done 5 timber deals or more. A majority of the timber deals (59.6%) had been initiated by the forest owner, while 11.5% had been initiated by the timber procurer and 17.2% was based on a tender from the forest owner. Timber deals that concerned more than 1000 m<sup>3</sup> were significantly more based on tender ( $p < 0.000$ ). Although not significant ( $p = 0.09$ ) it was found that timber deals based on tender were more common on large properties (101 ha or more) and that timber deals initiated by timber procurers were more common on properties in the size class 51-100 ha.

24.2% of the forest owners experienced problems in relation to the felling operation and of those only 54.7% were of the opinion that the problem had been resolved satisfactorily. The share of female forest owners that experienced problems during the felling operations was significantly higher than the share of male forest owners (38% versus 21%,  $p = 0.015$ ). Also significant more share owners experienced problems compared to single owners (27.3% versus 22.4%  $p = 0.028$ ) and there was a tendency that absentee owners experienced more problems compared to resident owners (31.0% versus 22.6%,  $p = 0.072$ ). Relatively more forest owners with a university degree indicated that they had experienced problems compared to forest owners with basic education ( $p = 0.0007$ ). The problems that were experienced by the forest owners concerned mainly the way the harvesting operation had been performed (41% of those that reported a problem) which in the opinion of the forest owner either had caused damage to the remaining forest land or lead to reduced revenues. Administrative problems were experienced by 12% of the forest owners, when payments had been delayed, miscalculations had been discovered or similar type of problems. Very few problems concerned the relation with the timber procurer (2%).

## Discussion

The sample taken for this study had a similar age distribution when compared to the age distribution of all forest owners in Sweden (Swedish Forest Agency 2013). This indicates that contrary to a number of other studies (Kuuvulainen and Salo 1991; Løyland et al. 1995; Bolkesjø and Baardsen 2002; Størdal et al. 2008; Joshi and Arano 2009; Joshi et al. 2013) age did not influence the harvesting behavior of the forest owners. In this study it was more common among the younger forest owners to have a loan on their property which according to Kuuvulainen and Salo (1991) should increase their willingness to perform a harvesting operation while older forest owner would not have the same economical need to do a harvesting operation. Interest levels on loans have however been moderate in Sweden during the recent years which may have subdued the need for harvesting among those with loans on their property. Bolkesjø and Baardsen (2002) found that in Norway on average only 10% of the total income came from timber sales which shows the limited economic need harvesting operations have for the family income today. Neither does the pattern found in this study fit to the explanations given by Törnqvist (1995) and Lönnstedt (1997). Their explanation was that

older forest owners like to save mature forests for the next generation as resources were needed to meet the costs of taking over by the next generation forest owners. Sweden abolished inheritance tax in 2005 which has reduced the costs of a take over. Also the practice of siblings taking over the property together has increased which will have subdued the need for capital to compensate family members by the new owners. But at the same time these changes in taxes and intergenerational transfer norms do not explain completely why older forest owner would increase harvesting or younger forest owners reduce.

The fact that the size of the property matters for the inclination to do a harvesting operation as shown in figure 2, was also found in studies by Kuuvulainen and Salo (1991), Bolkesjø et al. (2007) and Størdal et al. (2008). According to Størdal et al. (2008) forest owners with a management plan are more inclined to do a harvesting operation and it is more common among large forest owners to have a management plan than among small owners. Figure 2 showed that large properties also made more intensive harvesting operations. Størdal et al. (2008) found that education level had a positive effect on the decision to make a harvesting operation and more weakly on the intensity of the harvesting operation. Their explanation was that higher education may give the property owner more insight in the possibilities of the forest resources and that they also might be burdened with more debts. In this study there was a positive tendency ( $p=0.09$ ) that owners with a high education had more intensive harvesting level compared to owners with a low education while there was no significant relation between the size of the property and the education level. Størdal et al. (2008) also found that properties close to urban areas had a low harvesting intensity, a factor that was not considered in this study. Vokoun et al. (2006) found that the harvesting intensity decreased with increasing property size. Besides that, the intensity of harvesting was also affected by the length of the ownership as well as the fact whether or not the owner was an absentee owner (Vokoun et al. 2006). No such relations could be found in this study. Figure 3 showed that the ownership form influence the decision to harvest which was also found by Lidestav and Berg Lejon (2012). Interesting is though that share owners to small properties are more active than single owners to small properties, while single owners to large properties are more active than share owners of large properties. One possible explanation may be that single owners to large properties more often have focus on the economic objectives of ownership (Ingemarson et al. 2006).

If we would compare the share of female forest owners in our sample (21%) with the total share of female forest owners in Sweden (38%, Swedish Forest Agency 2013) it would appear that gender has a major impact on the decision to perform a final felling. However, it is important to keep in mind that the forest owners' gender in our sample concerns the contact person for the property and that this may underestimate the share of female forest owners to a property where a final harvesting activity had been performed (Lidestav 1998). This is strengthened by the fact no significant gender differences were found in ownership form or age while the studies made by Lidestav (1998) that female forest owners in Sweden are more often share owners than male forest owners and on average younger.

Members of forest owners' associations had significantly larger properties than non-members which is consistent with earlier findings of Berlin et al. (2006). They appear also to a high extent chose to sell their timber to the forest owners' association as 91% of their customers were members. However it must be kept in mind that membership is often established in connection with a timber deal (Kronholm and Staal Wåsterlund 2013), so to what extent the forest owners already were members when deciding to make the timber deal with the association cannot be determined based on this data. It was however found that members had not changed timber procurement organization as much as non-members and as such seem to some extent acknowledge the expectation that membership implies, which is to deliver their timber to the association. Enander and Melin (2008) found that forest owners reasoned more business like if the timber deal concerned relative large amount of timber. This was also found in this study as large timber deals more frequently were put out on tender.

Half of the forest owners that had made timber deals before had changed timber procurement organization. This is not consistent with the findings of Lönnstedt (1997). One possible explanation might be the difference in questions ask between the two studies. Lönnstedt (1997) asked for

hypothetical reasons to change, while this study asked if they had changed. Another explanation might be that the concept of loyalty in doing business has changed. Hakelius (1996) found that younger farmers did not perceive the need to be loyal to their farmer cooperative in the same way as the elder generation farmers perceive this and she explain this by the change in society and the growing need among people for individualism.

Approximately one out of five forest owners experienced problems with the timber deal. The results showed also that the growing category of female, share and/or absentee owner have experienced more problems than traditional owners. There may be a difference in expectations what a timber deal implies which the industry need to understand and address. Kindstrand et al. (2008) pointed out that forest officers do not always understand the forest owner's objectives and management ideas. Communication about the activity to be performed may also be hampered as younger forest owners might not be as familiar with the forest terminology as the elderly forest owners (Sjödén 2010). To establish long-term customer relations it is imperative for the companies to have knowledge about and understanding for the forest owners' reasoning with regards to their property (Peelen 2005).

For only 2% of the forest owners it was the first time they sold timber. This low number may be caused by the response rate to the questionnaire which was higher among the elderly forest owners. It may also be the result of the low share of take overs of forest properties which made it possible for timber procuring organisations to rely on experienced business contacts. However as the average age of the forest owners' population is increasing, it may imply that the take over frequency will increase in the future. Our study indicates that timber procuring organisations may need to invest in quality measures as well as consumer relations to ensure timber supplies from loyal forest owners in the future.

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# Quality assurance practices in the Swedish sawmill industry

Åsa Gustafsson<sup>1</sup>, Jimmy Johansson<sup>2</sup>, Lars Eliasson<sup>3</sup>

<sup>1</sup> Faculty of Technology, Linnaeus University, S-351 95 Växjö, Asa.gustafsson@lnu.se

<sup>2</sup> Faculty of Technology, Linnaeus University, S-351 95 Växjö, Jimmy.johansson@lnu.se

<sup>3</sup> Faculty of Technology, Linnaeus University, S-351 95 Växjö, Lars.eliasson@lnu.se

## Abstract

Sawmills are experiencing a turbulent environment in which customers' expectations and global competition set the landscape for the sawmill industry. Increasing competition and complexity, as well as the general technological development in the business environment, have enhanced the importance of quality with regards to both products and services. Hence it is important for sawmills to be able to offer a high quality of its products and services to its customers. The purpose of this paper is to identify the currently existing quality assurance practices in the Swedish sawmill industry.

This study is conducted as an interview study, in which five sawmill representatives were interviewed with regards to, for instance, their quality assurance process and quality measurements. The study concludes that the individual sawmills work to either an ISO-9000 or strength grading certificate and hence they adhere to certified procedures and routines. This research, however, does not register actions taken in every-day business, and hence additional studies would need to be conducted with an in-depth case study approach in order to identify the actual behavior at each sawmill. The studies identify factors limiting sawmills in their work to meet customers' requirements; however, customers asking for additional requirements are often denied delivery of products. This study aims at laying a foundation regarding sawmills' quality assurance practices and thus covers an unexplored area within sawmill research.

**Keywords:** Interview study, softwood, structural timber

## Introduction

Increasing competition and the general technological development in the business environment have enhanced the importance of quality with regards to both products and services. Technological progress has provided several possibilities for production managers to get "better" control of the performance of a company's production plants (Colledani, M. and Tolio, T. 2011). In industrial markets customers have become more and more powerful and are stating specific requirements with regards to products and services from their suppliers. Hence, assessing customer requirements with regards to quality and service becomes essential for survival for supplying companies. In order to fulfill customers' requirements, implementation of quality assurance practices becomes essential in allowing companies to offer a respectable quality for their products and services. Quality assurance can be defined as a "set of activities and attitudes in the firm that promote collective involvement to work in a process of continuous improvement and product and service quality assurance" (González-Benito and Dale, 2001). In this context quality assurance practices ought to be understood as practices that aim at reducing defects and improving performance of the products and services. Quality assurance can be viewed from an internal perspective, in which certification systems ought to be stressed.

The sawmill industry plays an important role in the Swedish economy; in 2012 about 12 million m<sup>3</sup> of softwood lumber was exported to a net export value of SEK 22B (www.scb.se). In general, there is a surplus of softwood lumber, and competition amongst individual sawmills is immense (Järvinen et al. 2010). Softwood lumber is in many cases referred to as a commodity product which is sold on the

world market (Roos et al. 2002). Commodity products have identical product characteristics, with a focus on competition amongst the suppliers on price and availability (Robinson, Clarke-Hill et al. 2002). Consequently, the price of softwood lumber is set on the world market. For commodity industries, focus is on low production costs and services as a fundamental competitive strategy (Porter 1998). Logistics are in general a cost requirement and hence focus on reducing such costs is essential (Harrison and van Hoek, 2011 and Jonsson, 2008). Sawmills are experiencing a turbulent environment in which customer's expectations and global competition set the landscape for the sawmill industry. Subsequently an individual sawmill has to continuously stress the need for increasing productivity and offer its customers stable quality and logistics service levels. In order to stress this issue a study by Lundahl (2009) concludes that there is a potential for Swedish sawmills to improve productivity by introducing process control tools such as Total Quality Management (TQM). TQM, being a philosophy aimed at performing the right activity the right way first time and to continue to perform it to the required level, has received much attention since its introduction (Ishikawa, 1985). In order to facilitate the TQM work, a number of quality management tools and techniques have been introduced. The number of quality management tools and techniques are plentiful. In order for the company to utilize the different tools and techniques effectively, it is essential to choose the accurate tool at the right time and to implement it appropriately (Chen, 2013). It is difficult to present a complete list of all quality tools as they are applied in different settings, as well as proposed by different scholars (see for instance Crosby 1979, Imai 1986, Evans and Lindsey 1999, Tari and Sabater 2004, Chen 2009). However, one common list of tools is the so-called "seven quality tools" (Ishikawa 1985; McConnell 1989). Dale and McQuater (1998) and Tari and Sabater (2004) extended this list of traditional quality tools with "new management tools" such as the affinity diagram and the matrix diagram, as well as systematic diagrams. Inherent in the concept of these quality tools lies the aim to measure and manage processes in order to obtain and maintain good quality. In order to actively contribute to quality development in all sectors of the Swedish society, the SIQ (National Committee for Swedish Quality) was founded in 1986. SIQ has developed a model for quality management based on three corner stones; systematic, structural and cultural. Systematic refers to the way of posing questions leading to an insight on how a business works; structural implies a public business model constituting the foundation for the questions, and cultural refers to the fundamental values of the business. (SIQ, 2014)

In order to fulfill the quality requirements, implementation of quality assurance practices becomes essential allowing companies to offer a respectable quality for their products and services. Sawmills experience a turbulent environment in which the customers are becoming more demanding, the price of the products is determined by the world market, and economies of scale in production has been focused for a long period of time. In order for an individual sawmill to become and stay competitive, assuring quality of its products and services become a question of survival. Hence the research question; How do Swedish sawmills assure quality of its products and services? The purpose of this paper is to identify the currently existing quality assurance practices in the Swedish sawmill industry as well as to identify potential areas for development of quality assurance practices. By knowing how sawmills assure the quality of their products and services, the foundation for quality assurance practices will be determined; thereafter it will be possible to identify potential areas for continuous work on quality assurance. The Swedish sawmills will benefit from this study by getting the area of quality assurance highlighted.

## **Method**

This study has been carried out as an interview study in which differences rather than similarities between the respondents were sought for. Table 1 presents the companies studied. A convenience sampling approach was used to identify the companies (Bass 1990). As is common in explorative studies, the companies were selected on the basis of diversity with regard to the market in focus. For this study only sawmills delivering softwood lumber for construction participated and the interviews were carried out in the fall of 2013. Each of the respondents was visited personally, and the interviews lasted approximately two hours. The interview guide was influenced and based on the model proposed by SIQ (SIQ 2014) focusing on the issues that are directly related to quality issues. The interviewees'

responses were complemented with other resources such as annual reports, sawmill Web pages and other types of written information regarding each sawmill. The interviews were conducted with one of the authors leading and the other recording responses. Each respondent was contacted after the interview to verify the responses and to provide an opportunity to change and correct misunderstandings, thus improving the validity and reliability (Yin 2003). Further identifying differences amongst the respondents sought to enhance external validity (Bryman and Bell, 2011).

Table 1. Description of the studied sawmills

Saw-mill	M <sup>3</sup> sold soft-wood lumber	Focus market	Co-operation Y/N	Quality assurance system applied	Definition of quality	What are the key processes and sub-processes? Which are the key requirements of these?
1	105 000	England	N	Strength grading	Meeting product quality specifications	- Sorting of logs acc. 80 % - Sawing – acc. 80 % - Drying - Grading – items/hour - Planing – meters and m <sup>3</sup>
2	150 000	England, the Netherlands	Y	Strength grading ISO	Meeting product quality specifications	-Procurement -Production -Sell
3	130 000	England	N	Strength grading	Meeting product quality specifications	-Harvesting – m <sup>3</sup> -Sawing – m <sup>3</sup> -Drying – m <sup>3</sup> -Grading – m <sup>3</sup> -Planing – m <sup>3</sup>
4	120 000	Japan, England	Y	Strength grading	Meeting product quality specifications	- Procurement, m <sup>3</sup> - Sawing, stop time - Drying, m <sup>3</sup> , efficiency -Planing, stop time
5	115 000	Denmark	Y	Strength grading	Meeting product quality specifications	-Sawing, efficiency, stop time - Grading, efficiency - Planing, efficiency, m <sup>3</sup> / min - Drying, efficiency, m <sup>3</sup> / hour

## Empirical findings

Table 2 describes the responses concerning identification of current and future customer demands. Table 3 presents how the interviewees responded to questions related to the assurance of achieving expected results concerning quality outcome of the production processes. In Table 4, results relating to the structuring function at SIQ, 2014 i.e. identification, prioritization, initiation, and implementation of process improvements in studied sawmills, are presented.

Table 2. Identification of current and future customer demands

Saw-mill	Collection of info.	Translation of customer requirements into the sawmill's processes	Ranking of customer requirements	How does the company use comments and complaints to improve its processes?	Id. of customer future demand
1	Telephone, mail, personal meetings	We saw the softwood timber that suits us.	Price Product quality	It depends on the size of the customer	When the customer calls
2	Telephone, mail, personal	We saw the softwood timber	Price	Failure report –	When the customer calls and if we like

	meetings	that suits us.	Product quality	problem is corrected	the idea, then we try to sell it to other customers
3	The customer calls and tells us	We saw the softwood timber that suits us.	Price Product quality Delivery precision	It depends on the size of the customer	When the customer calls
4	Through the sales organization	We saw the softwood timber that suits us.	Price Product quality	It depends on the size of the customer	We do not bother
5	Through the sales organization	We saw the softwood timber that suits us.	Price Product quality	Having a complaint is preferable, as you do not offer a product that is not too good for its price.	We do not bother

Table 3. Assurance of achieving expected result

<i>Saw-mill</i>	<i>How are deviations and risks in the process prevented?</i>	<i>How do you investigate the root causes of the possible problems?</i>	<i>How do you ascertain if the problem is solved?</i>	<i>How and when do you measure?</i>
1	Continuous maintenance and service 2-3 times per year	Cause and effect  Managed by the operating staff	Control requirements for each run in relation to metrics	We measure continuously
2	Daily controls, deviation reports according to ISO  Maintenance	Cause and effect	Controls until the problem is solved	We measure continuously
3	Daily controls  Maintenance	One employee is in charge per machine and the task is to ensure the best result	Tests until the problem does not persist	We measure continuously
4	We follow the processes in real-time systems and will be alerted if the values are outside those limits  Maintenance	There is one employee in charge per machine and the task is to ensure the best result	Tests until the problem does not persist	We measure continuously
5	We follow the processes in real-time systems and will be alerted if the values are outside the limits  Maintenance	There is one employee in charge per machine and the task is to ensure the best result	Tests until the problem does not persist	We measure continuously

Table 4. Identification, prioritization, initiation, and implementation of process improvements

	<i>How do you identify, prioritize and initiate process improvements? How do you use the results regarding measurements and other follow-ups to support the decision?</i>	<i>How do you implement the improved process? What are the different methods and tools applied?</i>	<i>How do you assure the improved processes' result?</i>	<i>How do you secure that all employees have suitable knowledge for their tasks?</i>
1	Investments for meeting legal requirements are always done.  Use of quality tools (for instance flow charts and cause-and-effect diagrams) identifies bottle necks.  We utilize the pay-off method	Purchase what is needed and then install	We install - then we measure	At least one employee per shift and work station have personal licenses for strength grading
2	Investments for meeting legal requirements are always done.  At monthly meetings, we decide on what should be done to improve overall efficiency	We just do it!	We install - then we measure	We have descriptions of all work stations and in personal meetings (regularly once a year) with the employee we decide what each employee needs to learn
3	Investments for meeting legal requirements are always done.  We make improvements that affect the quality of the products	Purchase the necessities, install and educate internally.	We install - then we measure	We make sure that each operator enrolls in the internal courses needed for them in order to conduct their work.
4	We divide investments into three categories 1) Necessary 2) Quality Improvements 3) Bottlenecks. Regarding necessary investments - we prioritize, and regarding the other two - pay-off time. We compare us with our competitors and see what we would need to invest in.	- Make a time plan - Define a group - Do the installation - Test - Train the employee	We install - then we measure	We make sure that each operator enrolls in internal courses needed for them in order to conduct their work.
5	We identify bottlenecks and identify how the bottleneck would move following a particular investment in two categories; legal requirements and efficiency improvements. Investments regarding the category of legal requirements are always conducted, whereas investments regarding category efficiency improvements are based on pay-off calculations.	Purchase by the central purchasing department, installation, training test	We install - then we measure	Each employee starts his/her position by joining other employees in order to learn, internal courses, external courses

## Discussion

For the individual sawmill, there appears to be two ways of collecting information from the customers; either through direct customer communication (such as e-mails and calls) or through the sales organization. The use of a sales organization depends on the internal organizational structure of the sawmill and the management of the co-operation. Further it appears as if the sawmills do not actually consider the customers' requirements, as all interviewees state that their sawmill saws the softwood timber that suits them. The product more or less completely follows a standardized commodity product with standardized grading rules. Additionally the interviewees are unified in their opinion that the customers rank a low price as the most important criterion, low price being closely

followed by good product quality (i.e. meeting the standard assured through quality assurance system). Regarding the sawmills' view on complaints, there is slightly different view amongst the interviewees; a majority state that it depends on the size of the customer, one states that it handles all types of complaints, and one states that having complaints is preferable, as the sawmill's offer is then not too good in relation to the price of the products. As a consequence this specific sawmill will lower its product quality until the customers start to complain, just to identify the borderline. Concerning future demands, most sawmills listen to their customers once they have contacted them and take action on inquiries if the business proposals include volumes large enough making it worth changing the existing production. However, two of the interviewees state that, generally, they do not bother trying to fulfill customers' special requirements since they disturb and complicate their normal production processes.

The prevention of deviations and risks in the processes differs between the individual sawmills. Interviewed sawmills with a large production volume have real-time alerting systems, whereas interviewed sawmills with smaller production volumes control the outcome of the production process daily. All sawmills conduct maintenance on their machines; some of the interviewed sawmills conducting planned service on the machines throughout the production time. A majority of the studied sawmills utilize the concept of work stations with the responsibility assigned to one specific employee. The assigned employee is responsible for identifying root causes, correcting and controlling. No sawmill, however, describes how they structure this process. All sawmills measure the outcome of their production processes continuously concerning effectiveness, and most companies have procedures to use this data to identify improvement needs. All of the studied sawmills appear to assure the outcome of their processes similarly.

All sawmills make investments that are necessary for meeting legal requirements. Differences could be viewed regarding other investments; some appear to make investments that improve the product quality, and some make investments in order to reduce bottlenecks (thereby enabling increased production volume). It appears as if all the interviewed sawmills conduct the implementation of investments in a similar manner i.e. they purchase a product, put it in place, educate their employees, and measure the outcome. All of the studied sawmills appear to educate their (newly) employed personnel within the organization, and in alignment with the requirements stated by certification system.

## **Conclusion, delimitations, and future research**

This explorative research concludes that the studied sawmills assure the quality of the products and services by following the certification system and reaching an acceptable level of product quality according to the grading standards. The product in focus (softwood lumber for construction) is a commodity product, and the willingness for the individual sawmill to shift its focus appears to be low, most likely due to economies of scale in production. The study indicates that sawmills, in reality, do not directly reflect on customer requirements; instead they focus on production volume and economies of scale in production. On the other hand, legal requirements on the product (softwood lumber for construction) are well specified, and certification is necessary according to specified standard building specifications. These building specifications differ between markets. Further, the customers' possibility to state additional requirements is concluded to be limited. This combination of set standardized requirements and economies of scale in production within the sawmills limits their willingness and ability to change. Interesting to note is that all interviewees state that they only ensure product quality and do not consider any other quality aspects such as logistics.

This research is delimited to sawmills producing construction timber and in the light of this, forthcoming steps in studying quality assurance in the sawmill industry ought to focus on another product and thereby include other actors; for instance sawmills producing softwood for the manufacturing industry such as windows and/or furniture ought to be stressed.

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# Performance indicators in the wood products industry – a review and study of a saw mill supply chain

Magnus Larsson<sup>1</sup>, Matti Stendahl<sup>1</sup> and Anders Roos<sup>1</sup>

Department of Forest Products, Swedish University of Agricultural Sciences, Box 7008, 750 07 Uppsala, Sweden, magnus.larsson.skog@sca.com

## Abstract

There is a need for customized tools capable of providing more holistic, integrated information about forest-based SCs. This study evaluates uses (current and potential) of performance indicators (PIs) for enhancing SC management in the wood industry. Literature on PIs in SCs is reviewed, and current use of PIs is analyzed in a survey study. The review distinguished PIs may be related to strategic, tactical or operational levels, and associated time horizons. As illustrated in Table 1, they may be financial (largely related to strategic goals) or non-financial (largely related to operational performance and the behavior of actors). Frameworks and methods for developing PIs depend vary according to the purpose. Goals of performance monitoring are described on retailing, processing and roundwood procurement levels. The case study reveals a clear negative correlation between customer orientation and distance from the market, i.e. a high degree of ‘responsiveness’ at the retailer end and concentration on efficiency at the supplier end of the supply chain. Further studies, including mapping exercises, and the combined effort to identify key performance areas, and developing performance indicators and measurements, are suggested.

## Introduction

Since the 1990s Swedish saw mills have shifted from producing mainly commodities to offering more value added and customized products (Staland 2002, Hugosson and McCluskey 2008, Roos et al 2008) through expanding supply chains (SCs) and vertical integration. A major driving force for the changes is that improving coordination and cooperation among partners in the SC is becoming increasingly important to maintain competitiveness. Thus, the companies now have much closer direct contact with their main customers and end-users.

For similar reasons, the industry has made strenuous efforts to improve productivity, efficiency and cost-effectiveness throughout the SC: in silviculture, harvesting, transportation, as well wood processing and manufacturing final products in the mills. Major efforts have been concentrated on each step in the chain (Hansen and Juslin 2011). Inventories are kept low, but this carries risks due to uncertainties and variations in both supply and demand. The drive to cut costs has been very successful in improving units’ efficiency (Ager 2012), and it remains highly important to continue efforts to minimize production costs to ensure competitive survival. However, performance measurements are mostly focused on minimizing costs of specific units or steps in the process chain. Much less attention has been paid to monitoring and improving the performance of the wood-based industry overall, i.e. the total costs and profitability for all actors in the SC.

This raises several questions regarding the optimal ways to ensure that future wood SCs meet new criteria to maintain competitiveness in a changing environment; the potential importance of applying a more holistic perspective; the potential need to improve the alignment and agility of SCs, and if so the required changes. According to Haartveit et al. (2004), enhancing control of the wood SC would cut costs, improve supply accuracy, provide opportunities for further product development, and improve the competitiveness of wood compared to the substitutes. This indicates that the focus should be shifted to the performance of the entire wood SC. Better measures and feedback from operational units involved at every step would enable managers to improve both the efficiency and agility of the entire chain. It would also help organizations to focus attention on the most crucial improvements. Key challenges are to identify the operations or processes that are most critical for the efficiency of

the chain and appropriate indicators of their efficiency (both individually and holistically). Another is to identify ways to compensate players if, for instance, meeting higher quality requirements would adversely affect a supplier, but improve overall profitability. However, this is beyond the scope of the present study.

Despite the importance of supply chain management (SCM) in the forest sector, relevant performance indicators (PIs) and the key variables (metrics) to monitor have been poorly researched, and there is a need for customized tools capable of providing more holistic, integrated information about forest-based SCs (Espinosa et al., 2010). Such tools should be based on a thorough understanding of wood SCs and provide timely knowledge of the flows and variations in both supply and demand, as improving the match between supply and demand would improve overall efficiency and profitability (Chopra & Meindl 2013). Thus, to improve the competitiveness of wood-based SCs there is a clear need to improve, develop, adapt and validate SC PIs.

## **Aims**

This study evaluates uses (current and potential) of PIs for enhancing SC management in the wood industry. The aims are to improve knowledge of PIs and the possibilities for enhancing the monitoring and control of wood-based SCs, by reviewing state-of-the-art performance monitoring, PIs and their applications then evaluating current performance and potential enhancements in a real life example.

## **Outline**

In the following section a deductive approach is applied to identify suitable methods for adaptation and application to assess performance in wood SCs: literature on PIs in SCs is reviewed and summarized. Then the current use of PIs and practitioners' perceived needs of enhancements are empirically and abductively analyzed in an interview-based case study of the SC of a saw mill in Sweden. The findings are then summarized, conclusions are drawn, and suggestions for further studies are presented.

## **Literature review**

Relevant literature was identified by internet searches via Google Scholar and Web Of Science using combinations of the terms 'performance indicators' or 'performance measurement(s)', 'supply chains' or 'wood supply chains', and 'saw mill(s). From more than 100 000 "hits" previous reviews and textbooks with some connection to the wood industry were chosen for closer study. Thus, the following review is based on a sample of the literature and should not be regarded as comprehensive. Rushton (2010) classifies uses of PIs in decisions related to three organizational levels and time horizons: strategic, tactical and operational. *Strategically*, they are used for top-level management decisions concerning, for example, financial plans, competitiveness and strategies for meeting company goals and plans. *Tactically*, they are used to allocate resources and facilitate efforts to meet strategic targets. *Operationally*, PIs are applied to acquire fresh, accurate data to help supervisors and workers set and meet routine and tactical objectives.

According to Maskell (1991), financial indicators are generally used in strategic planning, while non-financial indicators are applied in operational contexts to control day-to-day production and distribution. Regardless of type, Schroeder (1986) recommends use of PIs that are easily understood throughout the whole SC and difficult to manipulate. Other authors emphasize the importance of a holistic approach, since efficiency will not be maximized if the actors in an SC pursue individual goals (Lee and Billington, 1992) and use of accurate indicators covering the whole SC will enhance efficiency, cooperation and integration (Gunasekaran et al., 2004). These authors also stress the need for the PIs used to truly capture organizational performance, and recommend use of a few PIs that are critical for success, rather than the many frequently advocated by employees and consultants.

Gunasekaran et al. (2004) also presented a framework for studying PIs and metrics used in an SC environment, classifying them according to their application in four sequential SC activities identified by Stewart (1995) and Gunasekaran (2001): planning, sourcing, making/assembling, and delivering (to customers). These four classes of PIs are divided into 12 sub-classes according to their applicability at strategic, tactical and operational levels. In a case study of British companies the authors found that for strategic purposes, respondents considered non-financial performance metrics the most important for evaluating competitiveness. For example “level of customer perceived value of product” and “customer query time” were ranked highly important. “Supplier delivery performance” was the most highly ranked of all supplier link-related metrics. “Supplier ability to deliver goods in a timely fashion” was regarded as more important than price, because “Price has become the “order qualifier” rather than the order winner”. “Percentage of defects”, and “cost and capacity utilization” were top ranked among production metrics. A need for better forecasting techniques to eliminate (or minimize) uncertainties in the SC was emphasized. The authors conclude that monitoring performance at specific points of a SC does not necessarily improve it. To achieve positive results performance measurements and improvement studies throughout the SC are required. In addition, a good SC management program should include cross-functional and intra-organizational process and control, as well as being designed to be used and understood by all participants.

According to Lambert and Pohlen (2001), most performance metrics are company-or unit-specific, such as lead-time, fill rates and on-time delivery rates. Thus, they provide little information about the overall performance of processes in the whole SC. Metrics developed and used for a single actor (firm or unit) in the SC network do not capture the overall performance of the SC, or effects of each actor on it. Furthermore, many firms apply metrics to set rewards or incentives internally, thereby promoting an internal focus and potentially reducing overall profitability. The cited authors conclude there is a need to develop better SC metrics and overcome the implementation barriers. They advocate the development and application of more holistic metrics (aligned with strategic objectives), integrating financial and non-financial PIs, and hold that translation of such metrics into shareholder value is critical for resolving conflicting objectives and supporting trade-offs between SC actors. They also constructed a seven-step framework for developing aligned PIs in a link-to-link approach (firm-to-firm) to maximize shareholder value for an entire SC. It involves mapping the whole SC, identifying key linkages and analyzing each link to determine where additional value can be created. Finally, Lambert and Pohlen (2001) conclude that overall profitability can be maximized by using customer and supplier reports (profit and loss statements) to optimize profitability at each link, and non-financial metrics to align the behavior of individual actors with overall objectives and financial goals.

Various authors (e.g. Beamon, 1999; Bourne, 2002; Van Aken and Coleman, 2002) have identified key challenges when designing a performance measurement system, including: choosing a balanced set of metrics that drives actions towards strategic goals; ensuring measurability and easy access to required information; and avoiding metrics that promote undesirable behavior, such as local minimization or maximization that is not aligned with overall SC goals. Beamon (1999) argues that performance metrics should cover *resources*, *outputs* (products and deliveries to customers) and *flexibility* (for handling uncertainty).

SC activities have also been categorized for performance evaluation purposes, by grouping those related to: strategic supplier partnerships; customer relationships; information sharing; information quality; lean practices, and postponement (Li, 2002).

Espinoza (2010) noted that despite research on SCM in the wood products industry, little attention has been paid to development of performance measurement systems in wood products SCs. He also suggested a framework for developing wood SCs, focusing on *product quality* and *time performance* measurements linking the performance of different business units in the SC. The framework is based on suggestions by Lambert and Pohlen (2001), and consists of five steps: 1) mapping the value stream of a single product component from lumber manufacture to final delivery; 2) defining critical performance areas where the SC has to perform particularly well to create customer value; 3)

identifying relevant SC entities for key performance-related variables; 4) defining and calculating the required SC metrics; and 5) assessing the robustness and sensitivity of the system and making appropriate changes.

There have also been several attempts to construct multi-objective performance models, covering SCs wholly or partially. Notably, Sabri and Beamon (2000) developed an integrated multi-objective SC model for use in simultaneous strategic and operational SC planning. The model incorporates production, delivery, and demand uncertainty, and provides a multi-objective performance vector for SC networks, in order to aid the design of efficient, effective, and flexible SC systems and evaluation of competing SC networks. In addition, efforts to create a common tool for SC management resulted in the Supply Chain Operations Reference (SCOR) Model, a reference process model and management tool endorsed by the Supply Chain Council (SCC; <http://www.supply-chain.org>). It is based on three “pillars”. The first pillar is process modelling, where supply chains are modelled using building blocks and a common set of definitions. The second comprises performance measurements, via (potentially) more than 150 key indicators of the efficiency of SC operations with various levels of aggregation. The third is a “best-practice pillar”, involving comparison of current SC performance with “best practice” benchmarks derived from experience of SCC members. SCOR is based on the plan-source-make-deliver sequence of SCM processes (Stewart, 1995; Gunasekaran, 2001) and has been adapted to forestry in the Flexwood project (Westlund and Furness-Lindén, 2010).

Another well-known performance management tool, or system, is the Balanced Score Card (BSC), designed to help managers track the execution of activities and monitor their consequences. A BSC records measurements of a mixture of financial and non-financial metrics, each compared to a target value. The selected metrics should be those that are most important for efficiency and relevant to the organization’s vision, mission, goals and strategy (Kaplan and Norton, 2001). Four steps are required to design a BSC: translating the vision into operational goals; communicating the vision and linking it to individual goals; business planning/index setting; and finally feedback and learning. According to the original concept (Norton and Kaplan, 1992) a BSC should include four elements or groups of metrics, related to: financial status, customers (satisfaction and relations); internal business processes, and learning and growth. BSCs can be presented, for example, on an executive “dashboard”, focusing on important aspects of performance.

## **Synthesis of the reviewed literature**

To summarize the review, PIs may be related to strategic, tactical or operational levels, and associated time horizons. As illustrated in Table 1, they may be financial (largely related to strategic goals) or non-financial (largely related to operational performance and the behavior of actors). Hence, six groups of PIs are included in the table. Group A and B (strategic, tactical and financial) includes key performance measurements derived from the focal organization’s (or SC’s) Balance sheets and Profit and Loss statements. These metrics are often calculated and summarized either on annual basis or for part of the year, often quarterly. Group C (operational and financial) includes short-term financial measurements, e.g. cost per unit produced. Groups D, E and F (strategic, tactical or operational and non-financial) include parameters that are often difficult to define and measure, unlike financial parameters, since they have strong behavioral elements with high degrees of subjectivism and uncertainty. The level or degree of strategic fit should be included here, and the quality of communication in the supply chain (which is challenging to measure). Lead times, fill rates and customer-perceived values are other examples.

Table 1. Performance indicators grouped according to operational level and nature (financial or non-financial)

	Strategic	Tactical	Operational
Financial	A	B	C
Non-financial	D	E	F

It is important to harmonize short-term and long-term metrics. For example, if only operational costs are measured, but a higher degree of responsibility (customer orientation) is desired, there is an obvious risk of missing targets. This is a well-known problem that is frequently described in textbooks, for example Chopra & Meindl (2013, p 33) state that: “A company may fail either because of a lack of strategic fit or because its overall supply chain design, processes, and resources do not provide the capabilities to support the desired strategic fit.”

Frameworks for SC performance measurement recognize sequence of actions, e.g. “plan-source-make-deliver”, for which relevant PIs must be identified, and can be summarized or calculated and presented in tables.

Methodologies for developing PIs includes: mapping the focal SC, defining key performance aspects and indicators; defining appropriate metrics, measures and calculations; simulating and assessing performance using the defined metrics; validating the PIs; and finally applying the results to enhance SC performance. Figure 1 shows a generic methodology, adopted from Lambert & Pohlen and Espinoza.

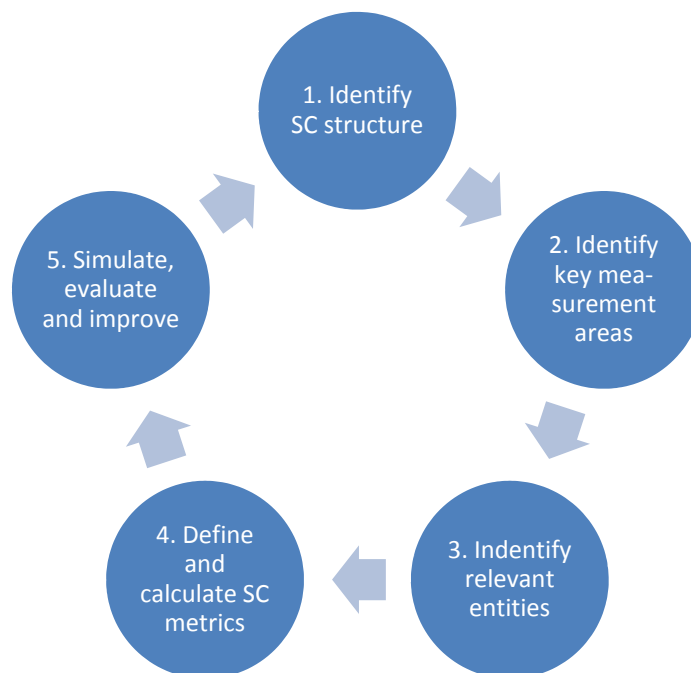


Figure 1. Sequence of steps in the development of SC performance measures (from Espinoza, 2010)

Several systems or tools have been developed for measuring performance, for example the Balanced Score Card, SCOR and the multi-objective SC model for use in simultaneous strategic and operational planning presented by Sabri and Beamon (2000).

### Case study

The studied SC is part of a vertically integrated forest product organization. It consists of a forest company, a saw mill company that has four saw mills and a sales organization, a pulp and paper

producing company, and several other production and transporting units. Sales are executed through internal sales organizations (UK, France and Nordic countries) or by external retailers. The production of sawn wood has quadrupled during the last 20 years and its importance has increased. In this study, the SC of one of the saw mills is investigated.

The forest company is the first link of the studied SC and responsible for supplying the saw mill with timber. The procurement is divided in two sub-links: regional departments are responsible for harvesting, bucking and producing timber at road side, and a timber procurement department is responsible for transporting and delivering raw material to the saw mills (or other industrial processing sites).

The saw mills are considered to be modern (following recent investments), well managed and efficient. They produce both value added and standard wood products (*inter alia*, furniture material, paneling, decking and building/construction timber) for either domestic use or export. The mills' customers are mainly wood industries and building materials merchants, mainly located in Europe, especially the Nordic countries, UK and France.

### Methodology for the case study

The performance and coordination of actors in the focal saw mill's SC were qualitatively studied, using open interviews. This was made by inviting actors involved in various parts of the chain to state their views regarding current performance and to suggest actions that could enhance the SC's competitiveness and profitability. Notes taken during the interviews and transcriptions were presented to the respondents for approval or comments. Finally, adjustments were made according to their comments.

The interviewees included 21 members of staff from the following components of the SC.

- ❖ Forest company (roundwood supplier): managers and supervisors of roundwood production, procurement and logistics
- ❖ Saw mill company (mills division): managing director, saw mill manager, marketing manager, supervisors
- ❖ Saw mill company (UK sales organization): managing director
- ❖ Saw mill company (Nordic sales organization): managing director
- ❖ Retail company (customer): owner/manager, supply manager

### Results

As shown in Table 2, responses of interviewees representing companies in three consecutive links of the mill's SC — the forest company (supplier), saw mill (manufacturer) and retailers (sales organizations/customers) — were summarized. Of the 21 interviewees, 11, six and four were representatives of the forest company, saw mill and retailers (two internal sales organizations and one external customer of the business group), respectively.

Table 2. Main findings from interviews with actors in the case study

	Main performance characteristics	Most important performance measurements used	Perceived aspects that could be enhanced
Retailers	- Customer orientation - Defining and creating	- Fill rates - Delivery precision	- Forecasting and prognoses from suppliers (saw mill –

	businesses and markets - Development of new markets - Fulfillment of agreements	- JIT deliveries	forestry) - SC communication - Alignment of goals within the SC - Delivery precision from mills
Saw mill	- Production efficiency and customer orientation	- Production efficiency measurements - Fill rates (from supplier) - <i>On time and In full</i> deliveries (to customers)	- Handling uncertainty and variation - Forecasting and prognosis from supplier
Forest company	- Efficiency in all actions - Deliveries of timber volumes to industry	- Cost per cubic meter - Delivery of volume of raw material - Fill rates (numbers of logs in diameter and length classes)	- SC coordination and cooperation - Alignment of goals and incentives - Market/customer (end user) orientation - Delivery precision (saw mill) - Calculation aids

Goals, incentives and follow-ups are mainly focused on the performance of the individual actor (retailer, saw mill, forest company). Furthermore, there seems to be a clear negative correlation between customer orientation and distance from the market, i.e. a high degree of 'responsiveness' at the retailer end and concentration on efficiency at the supplier end of the SC.'

At the saw mill, sales organizations and retailer the focus is on customer relations and fulfillment of orders and expectations, while the over-riding priorities of the supplier are to meet timber volume and delivery expectations while keeping costs low. Agreements are negotiated and fill rates (delivered numbers of logs in diameter and length classes) are monitored in the interface between the forest company and saw mill. Respondents from both forest company and saw mill stated that delivery of sufficient volumes is over-riding quality agreements (fill rates).

All respondents clearly expressed a desire for better coordination, cooperation and alignment in the SC, and recognition of a need for common tools and models for calculating benefits of investments for the entire SC, e.g. they stated that better prognosis of timber deliveries (length and diameter) would improve both production costs in the saw mill and customer relations.

They also stated that efficiency (in simple terms of minimizing local costs) is a major concern, and numerous metrics are used to measure it, in all steps and links of the SC. In contrast, quality measurements radically differ. In the retailer/sales links and saw mill they are largely related to customer-related issues. In contrast, in the forest company quality covers diverse elements, including (*inter alia*) silvicultural actions, environmental aspects of managing the forests and fill rates. Furthermore, current performance measurements mainly concern internal activities and are rarely

shared by multiple actors in the SC except fill rate measurements, which are shared by the saw mill and forest company, and the retailer and saw mill respectively. These are also the most important supplier-related metrics from the mill's perspective, while the most important metrics for the forest company are related to the efficiency of producing timber (harvesting and hauling) and transporting it to industrial processing sites.

Respondents reported that, occasionally, significant volumes can be moved from one destination (mill) to another to meet sudden shortfalls in supply. These volumes might not suit the bucketing requirements (length and diameter classes) of the new destination, and thus meet 'volume delivery' goals, but at higher costs of transporting and handling timber with deviant properties in the mill. These costs are rarely, if ever, calculated.

As the size of the mill has grown, so has its catchment-area for procurement. This has led to greater variation in properties of the timber reaching the mill. Variations in quality sometimes affect the quality of the mill's final products, hence some respondents expressed a belief that better prognosis and knowledge of the inbound timber's quality would help to meet end customer expectations.

The turnover time of raw material in the saw mill's wood yard is about a week, while replenishment takes at least one week, often more than two. Thus, when there are new bucking specifications there is delay of at least 1-2 weeks before timber with the ordered properties reaches the mill. Inventories are maintained at several points of the SC, but the data they contain are reportedly not uniform and it is difficult to acquire a summary or *snap-shot* of the properties of the timber in the flow.

Respondents from the forest company also expressed a view that demands from the saw mill are sometimes "unreasonable", i.e. incompatible with the condition of their stands. For example, logs of specified lengths and quality may be difficult (or impossible) to produce from the available raw material. Furthermore, their harvesting fleet currently includes some relatively expensive combi-machines to handle variations in supply and demand. Thus, these respondents believe that better communication and cooperation between the forest company and the saw mill would reduce harvesting costs, by increasing use of specialized harvesting machines for either thinning or final felling. If the variation were known or (better) minimized or eliminated, it would help scheduling and the use of combi-machines could be reduced.

Many respondents also stated that there are frequent deviations, mostly handled with a high degree of commitment and effort. However, problem-solving is highly dependent on previous experience. There is no (known) following-up or measurement of the costs of handling such deviations. Hence, variation is nearly always handled more reactively than proactively. Several respondents also gave examples of sudden changes in conditions that required substantial adjustment of procedures, and thus incurred significant costs, e.g. changes in deliveries or specifications, or shortfalls of raw material at the mill. However, they stated that there is no documentation of these occasions or adjustments to their knowledge.

In addition, one respondent expressed a belief that cultural differences among the forestry company, industrial and sales actors, together with a lack of knowledge, are greater hindrances than one may think. Thus, according to this respondent greater knowledge and a stronger focus on common goals would improve SC performance and reduce friction.

Overall, the respondents expressed a need for uniform business information throughout the SC, in order to harmonize the mill's requirements, harvesting plans, inventories of wood yard stocks, processing flows in the mill, further processing streams and deliveries to customers.

## **Conclusion**

For a long time there has been a strong focus on making each link in the SC efficient and streamlined, i.e. minimizing local costs while meeting delivery and quality criteria. Historically, this has been



appropriate and it is still important to keep costs low in order to maintain competitiveness. However, following the change in business strategy from producing standard (“bulk”) products to more value added products adjustments of the strategy for monitoring and optimizing efficiency are also required to improve the ‘strategic fit’. This could be done by adopting a more holistic perspective, i.e. maximizing the efficiency of the whole SC, while maintaining quality and sufficient responsiveness to requirements of other links in the chain (and end customers), especially for the value added products.

The case study reveals a clear negative correlation between customer orientation and distance from the market, i.e. a high degree of ‘responsiveness’ at the retailer end and concentration on efficiency at the supplier end of the SC, which creates tension among the actors. However, all of the interviewees appeared to share an equally clear, and strong, interest in enhancing communication. Efforts to improve cooperation and coordination between links have started, and all of the interviewees expressed a desire to contribute to overall SC profitability, but no appropriate measurement or decision support systems are available to them. Thus, there is a need to develop and implement such systems in order to enhance alignment of the SC actors. “We know exactly what everything costs, but we can’t calculate the benefits of an investment for either the next link or the whole chain”, as one respondent said. Appropriate performance measurements and incentives would help to integrate the SC more closely and thus meet this objective.

A suggestion for further studies is to apply the model presented by Espinoza; mapping and modeling the supply chain (organizations, processes, product flows, lead times etc.), identifying key performance areas, and developing performance indicators and measurements for the benefit of the whole saw mill SC. Key steps would include developing, testing and validating performance indicators and metrics for use as holistic decision support tools.

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# Consumers' environmental awareness towards children's furniture in Shanghai and Shenzhen, China

Minli Wan<sup>1</sup>, Anne Toppinen<sup>2</sup> and Jiao Chen<sup>3</sup>

<sup>1</sup> University of Helsinki, Department of Forest Sciences, P.O. Box 27, FI-00014 University of Helsinki, Helsinki, Finland, minli.wan@helsinki.fi

<sup>2</sup> University of Helsinki, Department of Forest Sciences, P.O. Box 27, FI-00014 University of Helsinki, Helsinki, Finland, anne.toppinen@helsinki.fi

<sup>3</sup> University of Helsinki, Department of Forest Sciences, P.O. Box 27, FI-00014 University of Helsinki, Helsinki, Finland, jiao.chen@helsinki.fi

## Abstract

China's rapid economic growth has increased consumers' disposable income evidently. With the improvement of living standards, Chinese people have increasingly concerned about their life quality, especially when buying consumable commodities like food, toys and clothing as well as durable goods like furniture for their children. In the past 10 years, the Chinese children's furniture market has developed rapidly, making up 9% of total furniture market in China in 2010. However, the children under 14 years old only account for 16% of the total population in China (The present market...China 2012). The disproportion between low market share and high population rate presents a tremendous potential market for furniture producers to develop the children's furniture industry. Along with people's intensified environmental consciousness, more and more Chinese parents have realized the growing importance of healthy and eco-friendly products, e.g., furniture, to children's growth. Despite some studies on the role of the lifestyle of health and sustainability (LOHAS) and the environmentally conscious consumerism in China (Dagevos et al. 2011, Sirieix et al. 2011), there is a lack of research on the analysis of consumers' environmental awareness towards children's furniture in China. The purpose of this study is to contribute to filling this gap.

In the empirical part, the survey was conducted with a quantitative approach and data were collected using a structured questionnaire in a sample of 320 consumers of 20-60 years old in two coastal metropolitan cities of China (Shanghai and Shenzhen in China) from December 2012 to January 2013. The data reveal 67% of females and 33% of males of 299 valid sample respondents. Since 63% of respondents were in the age group of 31-40 years old and 23% were in the range of 20-30 years old, the data set represents fairly young urban population. Results indicate that 83% of respondents chose solid wood as the primary raw material for children's furniture. From the Chinese consumers' perspective, natural, non-poisonousness and scentless material, adoption of environmental certification and verification of legal origin of wood are five key attributes of eco-friendly furniture. And the choice of eco-friendly children's furniture is connected to consumers' lifestyle of health and sustainability. Results also indicate that respondents with higher education had better knowledge and stronger awareness of environmental protection and sustainable lifestyle, and respondents with higher income were less price-sensitive and more aware of sustainable lifestyle. Although environmental awareness has increasingly become an important concern among Chinese consumers, they have low brand awareness and their price expectations on solid wood furniture are below current market levels. Despite these concerns, Chinese children's furniture presents a growing high-end market potential for both furniture producers and wood raw material suppliers.

**Keywords:** consumer, environmental awareness, children's furniture, Shanghai, Shenzhen, China.

## Introduction

China's rapid economic growth has increased consumers' disposable income evidently, encouraging the emergence of the lifestyle of health and sustainability (LOHAS) consumer segment. With the

improvement of living standards, Chinese people have increasingly concerned about their life quality, especially when buying consumable commodities like food, toys and clothing as well as durable goods like furniture for their children.

Since the mid-1990s, China's furniture industry has experienced steady and fast growth. Today, China is the largest producer, exporter and consumer of furniture worldwide (CSIL 2012). In the past 10 years, the Chinese children's furniture market has developed rapidly, making up 9% of the entire furniture market in China. However, the children under 14 years old only account for 16% of the total population in China (The present market...China 2012). The disproportion between low market share and high population rate presents a tremendous potential market for furniture producers to develop the children's furniture industry.

Along with people's intensified environmental consciousness, more and more Chinese parents have realized the growing importance of healthy and eco-friendly products, e.g., furniture, to children's growth. Despite some studies on the role of the LOHAS and the environmentally conscious consumerism in China (Dagevos et al. 2011, Sirieix et al. 2011), there is a lack of research on the analysis of consumers' environmental awareness towards children's furniture in China. The purpose of this study is to contribute to filling this gap by addressing the following two research questions: 1) Which factors affect Chinese consumers' buying decision on children's furniture? 2) What attributes make children's furniture eco-friendly from Chinese consumers' perspective?

## Literature review

In the theoretical background section, we overviewed the theory of consumer buying behaviour developed by Hawkins et al. (2001), which hypothesize that consumer buying behaviour is affected by both internal factors (e.g., personality, attitudes and lifestyle of consumers) and external factors (e.g., social-demographic factors such as demographics, culture, social status, reference groups of consumers, as well as product attributes such as price, quality and design, and supplier attributes such as reputation and service). We also overviewed recent literature concerning the environmental aspect of products in the context of consumer markets and marketing. According to Shamdasani et al. (1993), an eco-friendly product is the product that will not pollute the earth or deplete natural resources and can be recycled or conserved. It is a product that has more environmentally sound content or packaging in reducing the environmental impact (Elkington and Makower 1988, Wasik 1996). According to Toivonen (2007), environmental issues are increasingly relevant to the selection of wood products and they can be assumed to clearly contribute to the total product quality consumers perceive. Hansmann et al. (2006) find that in the case of Switzerland consumer sustainability orientation favouring ecological and social aspects as compared to economic aspects and to positively correlate with the intention of buying eco-labelled wood products. Furthermore, applying UK survey data of do-it-yourself companies, Toivonen (2007) concludes that it is important endowing wooden products with environmental information when the aim is to attract the customers with interest in the environmental quality of wooden products. Madrigal and Boush (2008) connect product social responsibility as a distinct brand personality dimension, so that consumers may be motivated to buy from a socially responsible brand as it allows them to also express their own personal values. Moreover, Toivonen (2012) states that environmental quality is a specific quality-related issue for wood products. High environmental quality is a strength for wood products and has an important impact on consumers' preferences for wood products (Roos and Nyrud 2008). Recently, environmental issues have increasingly been relevant to the selection of wood products and environmental friendliness of wood products is most clearly related to intangible attributes of products (Toivonen 2012). The benefits of improved environmental quality for producers include greater customer loyalty, lower price sensitivity and even the accrual of positive price premiums (Green and Peloza 2011).

On the other hand, lifestyle can reflect and inform consumers' self-concept or identity through a package of related practices (Axsen et al. 2012). In recent years, a series of fresh terms such as organic food, energy efficiency, ecotourism and socially responsible investing are frequently

discussed by the public (Ernst and Young 2007). Thus, a postmodern lifestyle called LOHAS (Lifestyle of Health and Sustainability) is derived. The LOHAS consumers are pursuing the conscientious consumption of products with health benefits that go in alignment with social justice, pursuit of ecology and sustainability. They are socially responsible and advocators of using green products. Therefore, LOHAS is an essential target for companies in marketing green or socially responsible products.

## Data and methods

In the empirical part, our survey was conducted with a quantitative method, and non-random sampling was based on the exit data in retail stores and other convenient places for meeting target groups. Data were collected by using a structured questionnaire in a sample of 320 consumers of 20-60 years old in two metropolitan cities of China (Shanghai and Shenzhen) from December 2012 to January 2013. Shanghai is the centre for furniture manufacturing and distribution in East China, while Shenzhen is one of China's special economic zones located in Guangdong Province in South China – the largest furniture manufacturing base in China. Both cities are regarded as the top target markets in China for high-end products because of their heavy concentration of middle-class consumers (Cao et al. 2004). The survey conducted in Shanghai includes furniture chain stores such as IKEA, big furniture centres like Block & Quayle – a British multinational do-it-yourself (DIY) and home improvement retailing company, and Red Star Macalline – the largest national furniture mall chain in China. Similarly, the survey conducted in Shenzhen includes IKEA, furniture malls like Bao'an and Xianghe, and Shenzhen Xiangjiang home furnishing European city. In order to ensure a broad cross-section of consumers to be involved in this study, the survey was also carried out in other places, such as kindergartens, primary schools, children's art schools, shopping malls, amusement parks, residence zones, and cinemas.

Data collection was based on the face-to-face investigation procedure. Passers-by were asked to fill a questionnaire with the assistance if needed. Each participant was provided with a small gift (chocolate or socks) for the cooperation. By standing beside them and assisting them in completing each question, unclear or blank answers would be avoided.

The questionnaire consists of two parts. The first part is a survey of consumers' perceptions of children's furniture, e.g., preferred material, acceptable price, information channels, brand awareness, environmental awareness, the factors affecting consumers' buying decision, etc. The second part aims at obtaining the background information of respondents, including gender, age, marital status, occupation, education, income, etc. The variables are either nominal or ordinal. Categorical variables involve background information and other additional questions, whereas numerical variables include questions that identify the factors affecting consumers' buying decisions on children's furniture. A five-point Likert scale was adopted to evaluate consumers' perceptions ranges from 1 = "Not at all important" to 5 = "Extremely important" or from 1 = "Totally disagree" to 5 = "Totally agree". The questionnaire was back-translated between Chinese and English versions in order to ensure the accuracy and efficiency of the information. It was initially pre-tested and modified to the final version.

The survey data were analysed with standard multivariate analysis methods, such as descriptive analysis, factor analysis and analysis of variance (ANOVA), using SPSS software. The basic descriptions of variables were determined by defining means and frequencies. As one technique of multivariate methods, factor analysis is used to reduce variables in a data set to a smaller number of components in order to explore the interrelations and potential structure in the data (Anthony 2011). According to factor analysis, separate dimensions of the structure can be identified and each variable is then explained by each dimension. In this study, factor analysis based on the Maximum Likelihood extraction method and the Varimax rotation method was conducted in multivariable descriptions related to the importance-ranking of factors affecting respondents' buying decision on children's furniture. Moreover, cross tabulations with chi-square tests and one-way ANOVA were used to run comparisons between respondents' background and their perceptions of children's furniture. Cross

tabulation illustrates the correlation between two or more variables on a nominal scale (Metsämuuronen 2012). ANOVA is a parametric test of comparing the mean values from more than two samples (Anthony 2011).

## Results

### Background information

According to the results, the overall questionnaire retrieval rate is 93%. Of 320 filled questionnaires, 299 copies are valid. While, Of 299 valid sample respondents, 146 are from Shanghai and 153 are from Shenzhen. The data reveal that females account for 67% of respondents and males account for the rest 33%. Since 63% of respondents are in the age group 31-40 years old and 23% are in the range of 20-30 years old, data set represents fairly young urban population. And the majority of the respondents is married and lives in urban area. The educational level of respondents is quite high, comprising 71% of college/university undergraduates, 17% of high school/vocational school diploma holders, 9% of university graduates or above. As regards the occupation, 60% of respondents are company employees, and 11% are entrepreneurs, and the remaining include government employees, teachers, blue-collar works, housewives and very few unemployed. The monthly income of respondents is centred between 10,000-20,000 RMB (35%).

Demographics describe a population in terms of its size, distribution (geographic location), and structure (gender, age, education, income, occupation) (Hawkins et al. 2001). Consumers' background information is essential to the analysis of comparing the perceptions of different respondent groups and how the demographic elements affect their perceptions.

With regard to the gender and age factors, results indicate that there were no apparent differences in perceiving children's furniture between males and females except that female and older respondents seemed to behaved more economically than males and younger people because they tended to change furniture within longer time period. For instance, 36% of females but only 19% of males were inclined to change children's furniture within 5-10 years, and the percentage of the respondents who decided to change children's furniture "Until the old one is worn out" increase with the accumulation of age (see Figure 1).

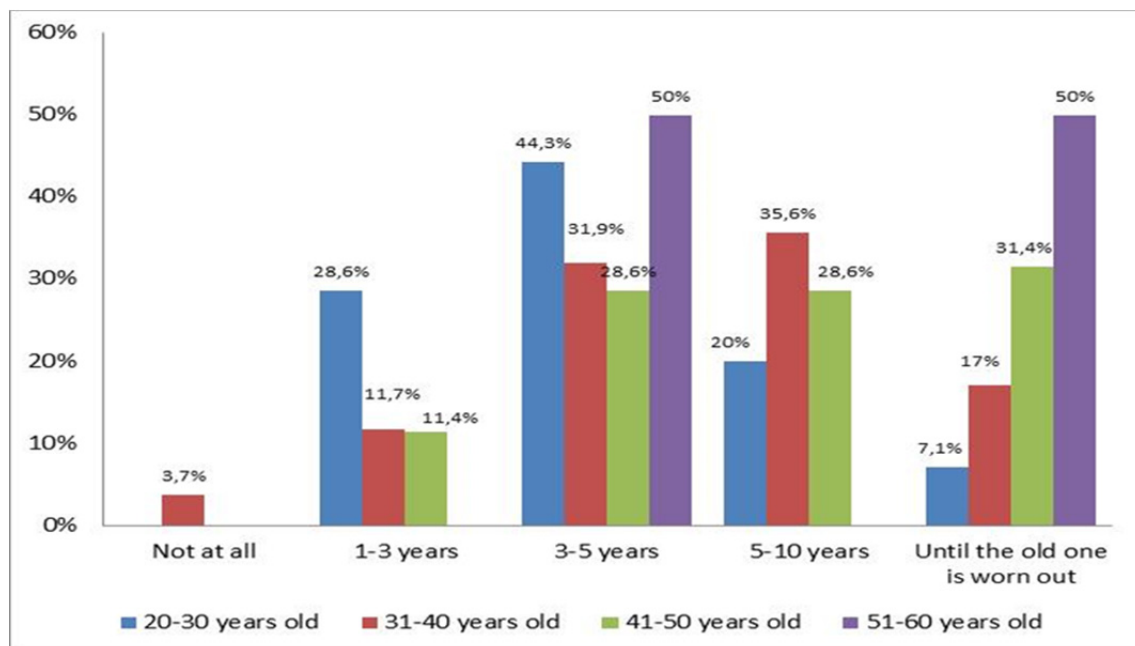


Figure 1. Frequency of changing children's furniture by age group

Slight differences in gender are also reflected in consumers' price preference and their attitudes towards lifestyle statements. As to price preference, females seemed to be more willing to buy children's furniture with higher price than males. As for attitudes to lifestyle, more females agreed that sustainable lifestyle was their family's goal than males. Regarding the educational level, the respondents with higher educational level had better knowledge and stronger awareness of environmental protection and sustainable lifestyle. Concerning the income factor, consumers with higher income possessed more children's room and furniture, and they were less price-sensitive and more aware of sustainable lifestyle.

*The factors affecting consumers' buying decision on children's furniture*

To discover the factors affecting consumers' buying behaviour on children's furniture, the respondents were asked to evaluate the importance of 16 product-related attributes based on 5-point Likert scale from "1 = not at all important" to "5 = extremely important". Factor analysis was selected as the main method to evaluate these factors. Based on their answers, 13 variables were grouped into four factors – supplier dimension, intangible product dimension, tangible product dimension, and environmental dimension of raw material, as shown in Table 1. Whereas, three variables ("Domestic wood", "Imported wood" and "Service") acted as interference items when grouping correlated variables into smaller dimensions of factors, and they had the highest loading on an incorrect factor dimension or an almost equal loading on more than one factor, which made the dimensions difficult to measure. So, they were removed.

Table 1. Factors affecting consumers' buying decision on children's furniture

Number of variable	Name of variable	Number of factor	Name of factor
A5j	Brand	1	Supplier dimension
A5k	Production technique		
A5p	Location of store		
A5o	Reputation of producer		
A5g	Visual appearance	2	Intangible product dimension
A5f	Style (Design)		
A5i	Durability	3	Tangible product dimension
A5l	Functionality		
A5b	Good quality		
A5a	Reasonable price		
A5m	Environmental friendliness	4	Environmental dimension of raw material
A5h	Safety		
A5c	Natural material		

As the strongest factor group, Factor 1 "Supplier dimension" explains 11.9% of the variance. It concerns variables that include supplier attributes. Brand, production technique and location of the store have strong factor loadings, with reputation having a slightly weaker loading. Factor 2 "Intangible product dimension" explains 10.9% of the variance. Visual appearance and style (design) can be regarded as value-added attributes of the product, which belong to consumers' higher requirement for children's furniture. Factor 2 involves the variables of visual appearance and

style/design that both result in high communalities and strong loadings, implying that they correlate strongly with Factor 2. Factor 3 “Tangible product dimension” consists of variables that reflect consumers’ basic requirements when buying children’s furniture. It explains the similar variance (10.6%) as Factor 2 since they both are parts of product attributes. Durability and functionality show higher factor loadings than good quality and reasonable price, which manifests that there exists a much stronger correlation between the former two variables and Factor 3 than the latter two variables and Factor 3. In contrast, all the variables in Factor 4 “Environmental dimension of raw material” do not show strong loadings and communalities.

ANOVA test was applied to determine whether there are correlations between these four factors and some selected variables (with the significance level of at most 0.05). Based on results, only three variables represent significant differences in two factors. Table 2 indicates that the statistical significance was shown between Factor 3 and monthly household income and acceptable price of children’s furniture as well as between Factor 4 and marital status.

Table 2. Significant difference of ANOVA

		Monthly household income	Marital status	Acceptable price of a set of children’s furniture
		ANOVA (significance)		
Factor 1	Supplier dimension	0.372	0.879	0.174
Factor 2	Intangible product dimension	0.757	0.776	0.471
Factor 3	Tangible product dimension	<b>0.013</b>	0.086	<b>0.068</b>
Factor 4	Environmental dimension of raw material	0.256	<b>0.046</b>	0.184

Results also show a negative correlation between tangible product dimension and respondents’ income, implying that the respondents with lower income were more concerned about tangible product attributes such as price and quality. Similarly, a negative correlation was also found between tangible product dimension and respondents’ price preference for children’s furniture, indicating that the more price-sensitive respondents required more tangible product dimension. Moreover, there was a positive correlation between raw material dimension and marital status, meaning that married respondents were more environmentally conscious than single ones.

### Reference groups

In general, consumers are susceptible to reference groups’ influences in purchasing decisions. According to their importance-ranking in terms of family, relatives and friends as well as social media, apart from consumers themselves, their spouse played the most significant role in affecting buying decisions, followed by their children and children’s grandparents. Among other reference groups, social media (e.g., Furniture Forum and IKEA Community) succeeded relatives and friends in occupying a place in consumers’ minds.



## Information channels

In relation to information channels used by consumers for children’s furniture, the choice of furniture stores exceeded other options substantially, making up 61% of respondents. Such high proportion is followed by the Internet searching (41%). Besides, consumers sometimes acquired information from their relatives and friends (37%) as well as social media (21%).

## Important attributes of eco-friendly furniture from Chinese consumers’ perspective

Based on the results, 83% of the respondents chose solid wood as the primary raw material for children’s furniture, demonstrating that the awareness of environmental friendliness has become an important concern among Chinese consumers. And as environmental characteristics of raw material was regarded as one of four factors affecting consumers’ buying decision, their attitudes toward environmental aspects of children’s’ furniture was investigated. For this purpose, respondents were asked to select the properties of eco-friendly furniture based on some given variables. Table 3 indicates the results based on the analysis of frequency distributions and the statistical parameters such as mode and mean. With mode “5” and the highest means, the highlighted five variables – scentless, non-poisonous and natural material, adoption of environmental certification and verification of legal origin of wood – were regarded as five important attributes of eco-friendly furniture by Chinese consumers.

Table 3. Five important attributes of eco-friendly furniture from consumers’ perspective

Properties of eco-friendly furniture		Totally disagree → Totally agree					Mode	Mean
		1	2	3	4	5		
Variable		% of respondents						
A8a	Scentless	1	2	5.4	8.7	82.9	5	4.71
A8b	Non-poisonous			1.7	3.7	94.6	5	4.93
A8c	Durable	1.7	3	24.4	27.4	43.5	4	4.08
A8d	Recyclable	1.3	6.4	19.4	28.4	44.5	4	4.08
A8e	Environmental certification	0.7	2.3	9	18.1	69.9	5	4.54
A8f	Natural material	0.3	0.7	9.7	18.4	70.9	5	4.59
A8g	Legal origin of wood	0.7	1.3	12	15.7	70.2	5	4.54
A8h	Famous producer	3	5	29.1	27.1	35.8	4	3.88
A8i	No use of child labour	7	6.7	25.8	19.4	41.1	4	3.81

Since the choice of eco-friendly products is closely connected to consumers’ lifestyle, their attitudes to LOHAS were investigated. Table 4 illustrates that the majority of respondents expressed some features of the LOHAS as their primary family goal. Of six statements, the statements concerning healthy lifestyle, sustainable lifestyle and importance of using eco-friendly products for children’s healthy growth are ranked as the three most important ones, indicating a growing emergence of the LOHAS consumer segment in Shanghai and Shenzhen. Moreover, over half of respondents agreed with the statements “Choosing eco-friendly products will not limit my lifestyle” and “Individual’s

consumption decisions impact strongly on global sustainable development”, indicating that the majority of respondents had environmental protection intentions and they were willing to contribute to the global sustainable development.

Table 4. Importance ranking of lifestyle statements of eco-friendly furniture

Lifestyle statements		Totally disagree → Totally agree					Mode	Mean
		1	2	3	4	5		
Variable		% of respondents						
B10a	Buying eco-friendly products means paying higher prices	3.3	5	20.7	36.1	34.8	4	3.94
B10b	Healthy lifestyle is our family's goal.		0.7	1	17.4	80.9	5	4.79
B10c	Sustainable lifestyle is our family's goal.	0.3	0.3	6.4	22.4	70.6	5	4.63
B10d	Using eco-friendly products is important for children's healthy growth.		0.3	3	14.7	81.9	5	4.78
B10e	Choosing eco-friendly products will not limit my lifestyle.	4.3	6.4	13.4	23.1	52.8	5	4.14
B10f	Individual's consumption decisions impact strongly on global sustainable development.	6	9.4	18.7	23.7	42.1	5	3.87

## Conclusions

Along with dynamic economic growth, consumers' rising disposable income, increasing environmental awareness and changing lifestyle, the Chinese children's furniture industry has developed very rapidly and is expected to continue to grow. More and more Chinese consumers are concerned about the environmental quality of children's furniture. In addition, Chinese government has also taken some initiatives and implemented a standard in August 2012 to ensure the improved product safety and high quality of products in order to promote the healthy development of the children's furniture segment. All these factors provide great opportunities for developing the Chinese children's furniture industry.

However, as solid wood was regarded as the preferred material of children's furniture by Chinese consumers, such huge demand makes Chinese domestic furniture producers rely heavily on the import of wood raw materials. Other competitive threats come from rising costs, a lack of design originality and well-known domestic brands as well as pressures from foreign large-scale retailers and emerging competitors. Moreover, although Chinese consumers' environmental awareness has increased, their brand awareness is still low and their price expectations on solid wood furniture were below current market levels. In conclusion, as an engine for economic growth globally, China is still in the early stage of development of children's furniture market, which remains to be further standardized and strong brands need to be developed. Even though, this niche market segment presents a growing high-

end market potential not only for wooden furniture producers but also for wood suppliers requiring demonstration of sustainable and legally-sourced wood.

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# Logistics service requirements in the industry for producing pallet and pallet collars – identification and grouping of logistics service requirements

Åsa Gustafsson

Faculty of Technology, Linnaeus University, S-351 95 Växjö, Sweden, Asa.gustafsson@lnu.se

## Abstract

In general, the sawmill industry perceives softwood lumber to be a commodity product and its individual actors' traditional focus is on cost reduction. However, instead of focusing on cost reduction, focus ought to be drawn towards sawmills' total offers in which service is particularly stressed. Therefore, knowledge of the individual logistics service requirements and their internal grouping is of vital importance in order to be able to handle groups rather than individual requirements, thereby keeping costs low. About 20 % of the produced softwood lumber is used for pallets and pallet collars. Producers of pallets and pallet collars thereby constitute important customers to the sawmill industry. Despite this, studies regarding the producers of pallets and pallet collars' logistics service requirements are lacking. Hence the purpose of this paper is to identify and categorize logistics service requirements in the pallet and pallet collar industry. This paper identifies and categorizes the logistics service requirements demanded by sawmills; by learning which those individual requirements are, then knowing how they could be categorized is essential for the sawmills' business development.

This study commences with an interview study aimed at identifying individual logistics service requirements. Thereafter a survey study is conducted in order to be able to categorize the individual logistics service requirements. The study concludes that logistic service requirements, such as delivery precision and goods wrapped in plastic, are important logistic service requirements; there appears to be a standardized set of logistic service requirements required by this category of customer. As this research is constituted by an interview study as well as by a questionnaire study, it is not possible to identify the actual actions with regards to real trade-offs, made by the actors, which are made in business. Therefore additional studies need to be conducted with an in-depth case study approach.

**Keywords:** Sawmills, Softwood lumber, factor analysis

## Introduction

Meeting customer service requirements is generally accepted as a strategic source of competitive advantage. Customer service refers to a company's ability to determine customer needs and requirements and to respond to them accurately. Accordingly, customer service is the measure of how well the logistics system is performing in providing time and place utility for the products (Lambert et al. 1998). Hence the role of customer service in developing and maintaining customer loyalty is important. Naturally it becomes important to establish customer service policies according to customer requirements (Ballou 1999).

The sawmill industry plays an important role in the Swedish economy; in 2012 about 12 million m<sup>3</sup> softwood lumber was exported, to a net export value of SEK 22B (www.scb.se). In general there is a surplus of softwood lumber, and competition amongst sawmills is immense (Järvinen et al. 2010 ). Furthermore, softwood lumber is in many cases referred to as a commodity product which is sold on the world market (Roos et al. 2002). Hence the price of softwood lumber is set on the world market. Further, regarding commodity products, focus is continuously on costs and cost reduction. Sawmills are experiencing a turbulent environment in which customer expectations and global competition set

the landscape for the sawmill industry (Husson and Nybakk 2010). According to a sawmill manager for one of Sweden's largest sawmill cooperations, about 20 percent of the total costs for sawmills are experienced as logistics costs. Therefore achieving cost effectiveness in the distribution channels, and at the same time meeting customer logistics service requirements, is of great importance for the individual sawmill in order to stay competitive. The sawmills have different types of customers; for instance, the retail industry, the prefabrication of single family houses, and the pallet and pallet collar industry; each type of customer has different service requirements.(Gustafsson 2006)

According to Skogsvårdsstyrelsen (2009), 19 % of the total volume of softwood lumber is used for pallet and pallet collars, and as a majority of these actors purchase softwood timber they are important customers for the sawmills. Pallets and pallet collars are used for the transport, storage and handling of products (Jonsson and Mattsson 2011). Standardization regarding dimensions, quality, and shaping has been a prerequisite for the extended use of pallets and pallet collars. Standardization implies that consideration has been taken to material handling methods, handling equipment, and modes of transport. It implies too that pallets and pallet collars can be transported abroad. (Twede and Selke 2005) Producers of pallets and pallet collars have automated production lines implying that the incoming material needs to comply with specific product quality requirements and the possibility of sorting incoming material manually at the production line is limited. The product requirements are governed by ISO 18333 or SS-EN12246.

As markets become commodity markets, the need to create competitive advantage by offering value-added services is enhanced (Christopher 1998). Competition amongst suppliers of commodity products is primarily based on the suppliers' total offer (i.e. products and services). By having a standardized description of product quality accepted within the industry, and a product sold on the world market (implies setting a world market price), the possibilities for the individual sawmill lie in producing collars. By possessing this knowledge sawmills have the possibility to differentiate their offers to their customers through, for instance, logistics service requirements. Consequently the purpose of this study is to identify and rank logistics service requirements valid in the industry for the production of pallets and pallet collars, and thereby formulate competitive offerings to the industry. From a theoretical viewpoint, knowledge regarding logistics service requirements is lacking from the industry of producing pallets and pallet collars; this study is hence a complement to previous research. The paper continues with a theoretical description of the concept of logistics service requirements, chapter three focuses on the methodology applied, with empirical study and analysis being presented in chapter four. The paper ends with chapter five, which provides conclusions and implications for the study.

### **Logistics service requirements**

Logistics services are the processes for providing value-added benefits to the distribution channel in a cost-effective way (La Londe et al, 1988), and consequently they measure the effectiveness of the logistics system by creating time and place utility. Service could be divided into pre-transaction, transaction, and post-transaction elements. (La Londe and Zinzer, 1976). However, according to studies conducted by Nilsson (1987), pre-transaction and post-transaction elements are less applicable in the Swedish industry environment.

Logistics services can be defined as (Mattsson, 2002, page 139);  
*„, all value-added activities concerning the order-to-delivery process, and providing accurate information and services in accordance with the material flow.*

Following the provided definition of logistics services, a logistics service consists of services related to the physical flow, services related to information regarding the physical flow, and to value-added services related to the physical flow. Hence service can be divided into three parts: delivery service, information service and logistics service. The importance of each service element is determined by the situation. *Delivery service* is considered to be such services as delivery time and delivery precision. *Information service* is the customers' possibility of obtaining information during the business

transaction, concerning, for instance, order status and delivery notification. *Logistics service* denotes all other services that are complementary to the physical flow of products. This service element constitutes among other things bar-coding, special packages, and Vendor Managed Inventories. During recent years logistics services have increased in importance more than the other customer service elements. (Mattsson 1999) The general concept of logistics service has been expanded by Gustafsson (2003), who proposes the phrasing of the individual service elements to be; delivery, information and value-added logistics services.

Several studies have been conducted in order to identify individual logistics service requirements. Table 1 gives an overview of logistics service requirements from an industrial perspective.

Table 1. Previous studies including empirically identified logistic service requirements from an industrial user perspective

Author	Year	Industry	Logistic Service requirement
Cunningham and Roberts	1974	Valve and Pump (purchase of steel)	Ability to meet quoted delivery times
Lambert and Sharma	1990	Chemical	Accuracy in filling orders Ability to expedite emergency orders in a fast responsive manner Accuracy by supplier in forecasting and committing to shipment dates for custom-made products Completeness rate (Percentage of order eventually shipped) Rapid adjustment of rate and shipping errors Frequency of deliveries Order processing personnel located in market area Computer-to computer order entry
Gilmour et al	1994	Various	Delivery time Providing info about delivery Order accuracy Availability Packaging Delivery reliability Ability to fill complete orders Reasonable delivery estimates
Donaldsson	1994	Various	Order – Delivery time Delivery reliability Available information Transaction accuracy Flexibility
Gustafs-son	2006	House-building industry	Accurate products are delivered completely Order cycle time is reliable Orders are filled completely Quick correction of mistakes Short lead-time Possibility to meet special requests concerning delivery Specified delivery date when ordering Possibility to order in entities Keeping supplier stock at production site Bar-coded products

## Methodology

This study is conducted in two parts. The first part is an interview study part in which purchasing managers have been interviewed in order to identify individual logistics service requirements. The second part is a questionnaire study in which questionnaires have been used in order to collect empirical data with regards to importance of each individual logistics service requirement.

## Identification of logistics service requirements

In order to identify logistics service requirements, an interview study on producers of pallet and pallet collars has been conducted. Differences between the respondents, such as number of units, product line, and type of customers, have been sought, rather than the similarities. A convenience sampling approach was used. Using personal interviews allows for options that are not possible with other methods, such as explaining questions, pose in-depth questions and ensuring complete answers (Churchill, 1991). Hence interviews were conducted until no additional aspects were revealed<sup>6</sup>. The interviews lasted about two hours and a walking tour of the production unit lasted an additional hour; in total about three hours were spent at the interviewed company. In total nine interviews were conducted for identification of logistics service requirements. The interviews focused on logistics service requirements and were divided into two sections: the first set of questions focused on a general description of the company, while the second focused on the logistics service requirements as stated by the respondents with regards to their softwood lumber suppliers.

Each company was visited and the interviews were held with the Chief Executive Officer (henceforth referred to as the CEO) for the respective company (who in a majority of cases was the owner and hence the single informant problem ought to be reduced). The interviews were recorded and filed notes were taken. The material (transcripts and filed notes) was rewritten into a script for each respondent. These were then sent to each respective respondent for the correction of mistakes and to add additional information, thus improving validity and reliability (Yin, 2003).

## Ranking and Categorization

Based on the interview study, a questionnaire was constructed. The questionnaire was tested (as recommended by Dahmström, 2000) first on academics within the research area in order to secure measurement validity (see Bryman and Bell, 2011), and then practitioners in order to verify the questions with respect to their comprehensibility and relevance. The process of improving the questionnaire by using “reviewers” with different specialties (academics and practitioners) ought to strengthen the usefulness. The questionnaire consisted of two parts; the first part focused on descriptive questions and the second asked the respondents to mark the importance of each logistics service requirements.

In Sweden there are 83 producers of pallet and pallet collars, according to the PAR-register. To increase the response rate the researcher first contacted the respondent by telephone in order to briefly inform the respondent about the questionnaire and to ask for their participation. During the interviews, it turned out that companies with less than 10 employees did not purchase softwood lumber from a sawmill and hence they were removed from the list. Information regarding the respondents is presented in Table 2. If the respondent agreed to participate he/she was given the option of completing the survey over the telephone, electronically or on a traditional paper copy. By offering these options, the respondent could answer the questionnaire whenever they preferred (Fowler, 2002) The response rate was 93 %.

Table 2. Information regarding respondents

Total number of respondents	83
Small (less than 10 employees)	27
Declined participation	4
Number of responses	52
Total response rate	93 %

<sup>6</sup> This is in accordance with grounded theory presented by Glaser and Strauss

In the questionnaire, the respondents were asked to mark the importance of the different pre-defined logistics service requirements on a 1-5 Likert scale, where 1 was not important and 5 was very important.

It is appropriate to use factor analysis in order to analyse interrelationships among a number of variables and to explain these variables in terms of their common underlying dimensions (factors). It is a technique for reducing data with a minimum of loss information (Hair et al., 1998). Consequently, factor analysis is used in order to find the categories of logistics service requirements. According to Hair et al., (1998) factor loading greater than +0.30 ought to be considered as significant loadings. However, cutting off more stringent (of +0.40) in conjunction with VARIMAX ought to enable clearer factors to emerge.

In order to assess the validity of the results, follow-up interviews have been conducted. The respondents who declined participation were interviewed in order to validate the results. These respondents, in the follow-up interviews, discussed the results in the same manner and hence validated the results.

## Empirical study and analysis

### Identification of logistics service requirement

The logistics service requirements identified in interviews are presented in Table 3.

Table 3. Identification of logistics service requirements

Interviewee 1.	<ul style="list-style-type: none"> <li>○ Fixed delivery days (2 each week)</li> <li>○ Possibilities for quick deliveries</li> <li>○ High delivery precision</li> <li>○ Supplier hold stock on behalf of the customer</li> </ul>
Interviewee 2.	<ul style="list-style-type: none"> <li>○ High delivery precision</li> </ul>
Interviewee 3.	<ul style="list-style-type: none"> <li>○ High delivery precision</li> <li>○ Short lead-time</li> </ul>
Interviewee 4.	<ul style="list-style-type: none"> <li>○ Short lead-time</li> </ul>
Interviewee 5.	<ul style="list-style-type: none"> <li>○ High delivery precision</li> <li>○ Short delivery time</li> <li>○ Wrapped in plastic</li> </ul>
Interviewee 6.	<ul style="list-style-type: none"> <li>○ Short lead-time</li> <li>○ More than one dimension in one delivery</li> <li>○ Wrapped in plastic</li> <li>○ High delivery precision</li> </ul>
Interviewee 7.	<ul style="list-style-type: none"> <li>○ High delivery precision</li> </ul>
Interviewee 8.	<ul style="list-style-type: none"> <li>○ High delivery precision</li> <li>○ Flexibility in changing in orders</li> </ul>
Interviewee 9.	<ul style="list-style-type: none"> <li>○ Wrapped in plastic</li> <li>○ High delivery precision</li> </ul>

The identified logistics service requirements are (presented in alphabetical order); Fixed delivery days (2 each week), Flexibility in changing in orders, High delivery precision, More than one dimension in one delivery, Possibilities for quick deliveries, Short lead-times, Supplier holding stock on behalf of the customer, and Wrapped in plastic.

### Ranking and categorization

In order to increase the understanding of the importance of each logistics service requirement, mean and standard deviations have been calculated for each of them. Each logistics service requirement is presented in ranking order (based on means) in Table 4.



Table 4. Descriptive statistics for each logistics service requirement

<i>Logistics Service Requirement</i>	<i>Mean</i>	<i>Standard deviation</i>
High delivery precision	4,67	,706
Wrapped in plastic	3,37	1,858
Possibilities for quick deliveries	3,25	1,655
Short lead-time	3,25	1,655
More than one dimension in one delivery	2,44	1,685
Flexibility in changing in orders	1,96	1,371
Supplier holds stock on behalf of the customer	1,67	1,184
Fixed delivery days	1,50	1,245

The different logistics service requirements vary in mean and standard deviations; high delivery precision being the logistics service requirement with the highest mean value. The respondents have ranked high delivery precision as being very important, whereas, for instance, fixed delivery days appear to be not as important; this indicates that the producers of pallet collars are concerned about getting the ordered softwood lumber on time. Standard deviation increases for requirements that are ranked as average (i.e. 3) and it decreases as the mean decreases, indicating that the respondents are to a larger degree of similar opinions with regards to the requirements ranked as very important or not important. Sawmills, as suppliers to the industry for producing pallets and pallet collars, meet a customer who requires basic logic service requirements and hence they ought to focus on these in order to create value for their customers.

SPSS has been used in statistical analysis and the reduced factor structure is displayed in table 5. All non-significant loadings have been deleted and hence only significant loadings  $+0.40$  are indicated. After studying the scree plot, three factors ought to be involved in the factor analysis.

Table 5. Rotated Factor Matrix

<i>Logistics service req.</i>	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>
Wrapped in plastic	,991		
More than one dimension in one delivery	,477		
Fixed delivery days		,880	
High delivery precision			,595
Supplier holds stock on behalf of the customer			,550
Flexibility in changing in orders			,502

Extraction Method: Principal Axis Factoring, Rotation Method: Varimax with Kaiser

Short lead-time and possibilities for quick deliveries had a significant loading of 0,288 and 0,396 respectively are hence removed from the analysis

The factor analysis of the logistics service requirements identifies three factors. *Factor 1* includes “wrapped in plastic” and “more than one dimension in one delivery”. *Factor 2* consists of “fixed delivery days”, while *factor 3* consists of “high delivery precision”, “supplier holds stock on behalf of the customer”, “flexibility in changing in orders”, and “possibilities for quick deliveries”. According to Mattsson 1999, logistics services could be divided into delivery, information, and logistics services. This study identifies three factors; however the operationalization of the groups in Mattsson, (1999) is not coherent with the contents of groups proposed by this study. “Wrapped in plastic” and “more than one dimension in one delivery” are coherent with the group *Logistics service* whereas “high delivery

precision”, “supplier holds stock on behalf of the customer”, and “flexibility in changing of orders” are aligned with *Delivery service*. However, “fixed delivery date” is clearly not aligned with *Information service*.

## Conclusion and implications

This research takes its starting point in identifying eight logistics service requirements important for the actors in the industry for producing pallets and pallet collars when purchasing softwood timber. The study continues with grouping of the identified logistics service requirements. Knowing and understanding the customers’ logistics service requirements are an essential input in the sawmills’ work with developing and deploying a logistics strategy that aims at meeting customers logistics service requirements.

This research is based on the industry for producing pallets and pallet collars, and when removing the actors not sawing their own softwood lumber or having one sawmill within the cooperation, only 54 actors remained. Despite the high response rate, the number of responses for statistical analysis is low. Therefore this study needs to be complemented by additional studies. The additional studies need to deploy other methods, for instance in-depth case studies for identifying the actual actions taken by the actors, such as an in-depth study focusing on the conscious and unconscious needs of the respondents, as well as focusing on business models. A possible enlargement of this particular study is to focus on the respondents’ customers and the nature of the product (standard or special). This study complements previous studies by its operationalization of logistics service requirements. Further the identified factors are complementing previous studies by Mattsson (1999) and Gustafsson (2003). The industry for producing pallets and pallet collars is, from a sawmill perspective, the type of customer who has made the most in terms that resemble traditional manufacturing industries. The studied industry is characterized by low refinement, low inventory levels and rapid turnover, and this makes the actors dependent on their suppliers’ delivery of softwood lumber (which is reflected in the study's results). In order for sawmills to develop they therefore ought to examine these actors rather than others.

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# Operations management, cooperation and negotiation in the wood supply chain – the relationship between sawmills and sawlog suppliers

Matti Stendahl<sup>1</sup>, Emanuel Erlandsson<sup>2</sup>

<sup>1</sup>Swedish University of Agricultural Sciences, Department of Forest Products, PO Box 7008, SE-750 07 Uppsala, Sweden, Email: matti.stendahl@slu.se

<sup>2</sup>Swedish University of Agricultural Sciences, Department of Forest Biomaterial and Technology, SE-901 83 Umeå, Sweden, Email: emanuel.erlandsson@slu.se

## Abstract

Recent decades' development of technology in forest inventory, harvesting, logistics, and sawmilling have created new possibilities for better integration of sawmills' and sawlog suppliers' operations. This could largely increase value creation in the wood supply chain. However, industry practitioners indicate that integration still is at a fairly basic level and that the full potential of available technology is not used. The literature does not provide much information about the relationship between sawmills and sawlog suppliers and the reasons for this incongruity are therefore not well known. This study investigates the relationship between sawmills and sawlog suppliers in four Swedish cases. Semi-structured individual interviews and focus group discussions with respondents from a cross-functional sample in each case provided deep insights into operations management, cooperation and negotiation involved in the relationship. Function modeling (IDEF0) was used to map actors, activities and information flows in the negotiation process. The study indicates that managing social relationships is equally important as managing technology in the management of the wood supply chain.

# International trade of forest-based and wood products: analysing and modelling

Anne-Laure Levet<sup>1</sup>, Ludovic Guinard<sup>1</sup>, Indradev Purohoo<sup>1</sup>, Bertrand Koebel<sup>2</sup>, Phu Nguyen Van<sup>2</sup>

<sup>1</sup>FCBA – Department of Economics, 10 avenue de Saint-Mandé, F-75012 Paris, anne-laure.levet@fcba.fr

<sup>2</sup>BETA – University Strasbourg (France)

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## Abstract

Aim of this work is to analyse the international trade of forest-based and wood products as well as to underline the most important determinants of exchanges between countries. Products considered here are divided into four main categories: forest products (roundwood...), woodworking products (sawnwood, panels, elements of construction, packaging...), pulp and paper and furniture. In a first part, an overview of the international trade of forest-based and wood products is given as well as the evolution since 2000 based on UN Comtrade data. The international competitiveness of the main export countries is also analysed through market shares and revealed comparative advantage (RCA). In a second part, a modelling is proposed in order to underline the main determinants of international exchanges. A first equation is defined in the frame of the Heckscher-Ohlin-Vanek, or HOV, model which predicts that a country's net exports of a given good are a positive function of its resource endowment and a negative function of its income. Then, an enlarged equation is proposed in order to take into account industrial performance indicators in the explanation of the competitiveness of export countries. A focus is made on the Total Factor Productivity (TFP) calculated by using EUKlems data. Empirical tests are made on European countries between 1995 and 2007. They show heterogeneous results according to the wood products. The HOV hypothesis is partially confirmed and TFP is a significant determinant in explaining net exports of woodworking products.

**Key words:** forest-based and wood products, international trade, competitiveness, modelling

# Factors Affecting Sawnwood Consumption in Europe

Elias Hurmekoski<sup>1</sup>, Lauri Hetemäki<sup>2</sup>

<sup>1</sup>European Forest Institute (EFI), Foresight and Policy Support Programme, Joensuu, Finland

<sup>2</sup>University of Eastern Finland (UEF), School of Forest Sciences, Joensuu, Finland

## Abstract

Recent significant changes in the sawnwood consumption per capita in some European countries raise the questions, whether similar changes could happen in other countries as well, and if so, driven by what? The objective of this study is to identify potential factors affecting the level and growth rate of sawnwood consumption in Europe. Econometric models with sawnwood consumption per capita as the dependent variable are estimated for 17 European countries for the period of 1980-2012. The per capita form normalizes the data in regard to the size of the markets, and therefore makes the data more comparable across countries and over time. The results indicate that construction activity, the level of income, and prices explain the sawnwood consumption per capita satisfactorily in many European countries. However, the results point to large regional differences in the drivers of sawnwood consumption across Europe. In densely forested and scarcely populated regions, there have been structural changes that may have been caused by changes in the market share of sawnwood in the construction markets, which the models measuring economic activity are unable to capture.

**Keywords:** coniferous sawnwood; consumption per capita; demand modeling; Europe; panel data; PESTE analysis; structural change

# Closer customer relation to improve sawmill production and profitability

Staffan Brege<sup>1</sup>, Tomas Nord<sup>2</sup>, Daniel Nordigården<sup>3</sup>, Johan Holtström<sup>4</sup>

<sup>1</sup> Staffan Brege - Professor, Department of Management and Engineering, Linköping University; SE-58183 Linköping, Sweden; e-mail: staffan.brege@liu.se

<sup>2</sup> Tomas Nord – Assistant Professor, Department of Management and Engineering, Linköping University; e-mail: tomas.nord@liu.se

<sup>3</sup> Daniel Nordigården - Assistant Professor, Department of Management and Engineering, Linköping University; e-mail: daniel.nordigarden@liu.se

<sup>4</sup> Johan Holtström – Senior lecturer, Department of Management and Engineering, Linköping University; e-mail: johan.holtstrom@liu.se

## Abstract

Strategies in the wood mechanical industry have long had a production oriented focus aiming at high raw material recovery. This demands good knowledge of incoming raw material and well-invested mills. Competition has increased nationally as well as globally resulting in increased production, homogeneous products and lower margins for sawn wood products. A consequence is the closing of many companies. To improve competitiveness there has been an interest in establishing relations with customers to gain better knowledge of their demands and to produce more adapted products. The purpose of the study is to describe and analyse how production oriented sawmills can benefit from closer relation with customers.

A case study approach involving the relation between a sawmill and a wood based panel and flooring producer situated in northern Sweden was used. Interviews and company visits were done to create a clear picture of development of the relation and what activities and processes were changed.

The result indicates that the sawmill benefitted and was able to develop its production processes in numerous ways. The knowledge of customer demands affected the procurement of logs, a more efficient log sorting with fewer sorting bins, an efficient first break-down with longer runs due to fewer products, improved kiln-drying schemas, lower finished products storage and better planned and less costly distribution. In conclusion, the improved production efficiency came from better and more stable internal planning processes at the sawmill.

**Keywords:** long-term relations, wood products, dyad, production processes

## **Ecosystem services**



# Observations on CICES-based classification of ecosystem services in Finland

Olli Saastamoinen

School of Forest Sciences, University of Eastern Finland

## Abstract

Some aspects of past development are outlined in regard to the identification and classification of nature's benefits nowadays conceptualized as ecosystem services. The knowledge about the multitude and diversity of the useful benefits has grown tremendously and yet a large part of biodiversity is still unknown. The conclusion is that the variety and complexity of ecosystem goods and services can only be properly categorized and managed by using hierarchical classifications. The Common International Classification of Ecosystem Services (CICES) represents the most concentrated effort to develop hierarchic, systematic and multipurpose classification for ecosystem services. CICES has been applied for the classification of the services of major inland ecosystems of Finland: forests, agricultural fields, peatland and freshwaters. The major observations has been that the flexibility, which the hierarchic system provides for moving towards more detailed classification levels is really a needed advantage and was used in the classifications done. Sample examples from the expanded classification are given besides other observations. The results of the classification efforts, which are reported elsewhere, are first applications of CICES in the boreal ecosystems.

## Introduction

As a concept ecosystem services is relatively new but its substance is very old. If thinking the common interpretation of ecosystem services as "benefits people obtain from ecosystems" (MA 2005), it is clear that almost all past categorizations of the tangible goods ( products) of biological nature can be seen as classifications of provisioning services of ecosystems. Early observations on the adverse impacts of bad land management such as soil erosion and flooding or loss of aesthetic values have seldom been presented systematically but both are inverse identifications of what now are named as regulation and maintenance as well as cultural services of ecosystems.

In regard to forests, H. C. von Carlowitz (1713) in his "Sylvicultura oeconomica" gives a long list of forest benefits, from "the usefulness of wood at the start and end of life and mankind in general" to "protection of soil and roads, the usefulness of the forests as a seat of wild game, and sustenance for cattle, forests as beautiful environment for the song of birds". This is only a part of his list but one can see that provisioning, regulation and cultural ecosystem services are already there, although not in the form of the systematic classification.

Along the development of agriculture, forestry and other sectors using renewable natural resources the classification systems have become more detailed and systematic. Growing involvement of sciences not only reflected the utilitarian needs for nature's products but also intellectual aims to bring order into the biological richness of nature and its evolution.

Nobody has brought more order into the taxonomy of plants and animals as Carolus Linnaeus (Carl von Linné, 1707 -1778). He studied medicine at Uppsala but devoted his work on botany, an essential part of studies as doctors often prepared medicines from plants. *Genera plantarum* (1737) was not well taken first. The head of Botanical Garden in Oxford stated that Linnaeus had brought "the whole botany in disorder" although later agreed with him (Petrusson 2014)

The Linnaean biological classification system of plants has been used since 1758 only with some modifications. In this system, species and genera are further grouped into a hierarchical system of higher taxonomic categories: families, orders, classes, phyla and kingdoms (Purves et al 2006). Most

significant changes have been the number of kingdoms and most recently the preferred organization of three domains above kingdoms: Eukarya (all higher organisms), Eubacteria and Archaea (anaerobic bacteria). The latter two domains reflect increased microbiological and genetic knowledge. In all, the underground and microscopic organisms play an important role in the ecosystems contributing among other things to many regulation and maintenance services.

It has been told, that due to intensive writing and sitting with the two volumes of *Species plantarum* (1753) Linnaeus got pain in his right side. This was cured by his cure-all medicine, wild strawberries (Petrusson 2014).

While the take off from nature's products medicine has been the long-term trend in the development of modern medicine, the nomenclatures of medicinal plants show an increasing trend of their identification.

The classical "*Material medica*" from 1<sup>st</sup> century included c. 600 medicinal plants (Lavrenov and Lavrenova 1999). In Russia the handbook covers c. 2000 wild and cultivated medicinal plants (Lavrenov and Lavrenova 1999)

The modern biochemistry has enlarged the nomenclature of the products of medicinal and other useful plants and animals (e.g. insects, carnivores, herbivores, fish) into more specific elements - chemical compounds. In the Dictionary of Natural Products (<http://dnp.chemnetbase.com/intro>) these are grouped into c. 40,000 entries. Examples from 15 major entry classes are *Aliphatic natural products, Simple aromatic natural products, Flavonoids, Tannins, Lignans, Polycyclic aromatic natural products and Terpenoids*. These are keys for the identification of medical, nutritional and other useful functions of plants and other organisms and play role in the formation of related ecosystem goods.

The above highlights on medicinal and other useful plants and organisms indicate that the multitude of identified natural products already in this very specific part is extensive.

Biodiversity has often been recognized to be in the core of ecosystem services (MA 2005, TEEB 2010). The entire biodiversity of the world has sometimes been divided into three groups: 1) what we know; 2) what we know that we do not know and c) what we do not know that we do not know. Quite a lot of biodiversity of the world still belongs to the 2<sup>nd</sup> group and the potential of 3<sup>rd</sup> group can be assumed to be large. However, even the huge variety of the 1<sup>st</sup> one gives support to a statement that "it is virtually impossible to list all the ecosystem services let alone the natural products that people directly consume" (Sekercioglu 2010).

The conclusion from the above examples is clear: it is not possible to bring order into the multitude of tangible and non-tangible ecosystem services by adopting simple and pragmatic classification schemes. The variety and complexity of ecosystem goods and services can only be properly categorized and managed by using hierarchic classifications.

The aim of this paper is to present some observations and experiences found in the application of the Common International Classification of Ecosystem Services (CICES) for identification and organization of the goods and services of major inland ecosystems in Finland: forests, agricultural fields, peatland and aquatic ecosystems<sup>7</sup>.

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<sup>7</sup> This work is part of the project "Integrated and policy relevant valuation of forest, agro-, peatland and aquatic ecosystem services in Finland". Besides identification and classification, the project focused on concepts, history, indicators, valuation (methodological orientation) and policies related to the ecosystem services in Finland. The study was funded by The Maj and Tor Nessling Foundation and carried out by the University of Eastern Finland and Pellervo Economic Research PTT, supported by many voluntary individual researchers from other research organisations. Available reports can be found in electronic publications of the University of Eastern Finland, Pellervo Economic Research PTT and the Finnish Environment Institute.

## Observations on the CICES

Several classification schemes for ecosystem services have been developed before and after the Millennium Ecosystem Assessment. The former include Daily (1997) and de Groot et al (2002) and the latter TEEB (2010), UK NEA (2011) and the versions of CICES (Haines-Young and Potchin (2010, 2012 and 2013). Kettunen (2012) is a modified combination of MA (2005) and TEEB (2010) categories in the Nordic context. Haines-Young and Potchin (2012) and Maynard and Cork (2011) have cross-referenced or compared several ecosystem service classification frameworks.

Among the alternatives, the Common International Classification of Ecosystem Services (CICES) represents the widest and most concentrated effort to develop universal and hierarchic taxonomy of ecosystem services (Haines-Young and Potchin 2011, 2012, 2013, Maes et al 2013, Saastamoinen et al 2013, Turkelboom et al 2013).

The hierarchical structure allows the users to *go down to the most appropriate level of detail required by their application* (italics OS), and then group or combine results to making wider comparisons or generalised reports (Haines-Young and Potchin 2012, 2013, Maes et al 2013, Turkelboom et al 2013). The first draft of CICES appeared in 2009, within the context of the European Environmental Agency's (EEA) work on land and ecosystem accounts (Haines-Young & Potschin 2010). Since that it has been under continuous development, reported in different versions (Haynes-Young and Potchin 2011, 2012), the latest (January 2013) being version V4.3 (Haynes-Young and Potchin 2013). Changes has been due interactive considerations between the developer-coordinators and voluntary scientists interested in the CICES development and EEA.

Discussions and revisions have not concerned only structure but also the boundaries of ecosystem services and consequently what is and what is not regarded as an ecosystem service.

For example, water is included as drinking water and for non-drinking agricultural, domestic and industrial uses but from CICES version 4 onwards not any more as a source of hydropower, because abiotic services were excluded (Haynes-Young and Potchin 2012). From the point of view of Finland with her abundance of aquatic ecosystems (lakes, rivers and ponds) this boundary did not seem as crystal clear and has been discussed (Saastamoinen et al 2013). Anyway, in the context of the CICES Version 4.3. satellite account has been developed for all abiotic services (Haynes-Young and Potchin 2013).

CICES was first designed for economic accounting and had the focus on final services. Therefore it was important to exclude intermediate ecosystem services from final ones to avoid double counting (Haines-Young and Potchin 2012, 2013). However, sometimes the difference is drawn into water. Supporting services (often included into intermediate services) such as photosynthesis, water and nutrient cycles have been seen as a primary separate category, which are embedded into all three categories. For example, all primary biomass production is generated in photosynthesis. Similarly, the important role of water cycle can be seen already in the title of the Class (see next paragraph) "Hydrological cycle and water flow maintenance" being a part of Group "Regulation of flows" in the Maintenance and regulation services (Table 1a).

For a purpose to serve ecosystem service mapping and assessment, CICES adopted an additional fifth level. The levels of hierarchic structure are now Section, Division, Group, Class and Class type. Categories at each level are meant to be non-overlapping and without redundancy (Haines-Young and

Potschin 2013). Like MA 2005 and most other suggested classifications also CICES is framed around human needs.

CICES is meant to be multifunctional classification. It has even noted that “there is nothing on the design of CICES that would prevent it supporting social, moral and aesthetic forms of assessments” or to be used for physical accounting (Haines-Young & Potschin 2012, 2013).

### **Observations on the CICES-based classification of forest-, agro-, peatland- and freshwater ecosystem services**

In this study the goods and services of each of the four ecosystem (forests, agricultural fields, peatlands and inland waters) were classified separately. In the beginning CICES version 4 was the current one and was followed in the classification of water ecosystem services (Alahuhta et al 2013) and agroecosystem services (Arovuori and Saastamoinen 2013) as well as in making first drafts for forest and peatland ecosystem services. When CICES version 4.3 was published, forest classification was drafted again using the new version (Saastamoinen et al 2014 b, in process). For the synthesis report of the study (Saastamoinen et al 2014 a), a less detailed integrated synthesis classification was done so that all services included were brought into CICES version 4.3.

The borders between the ecosystems are seldom clear-cut in the nature, as the transitions are smooth. One exception is the border between aquatic (lakes and rivers) and terrestrial ecosystems. Also agricultural fields as an intensively managed ecosystem differ easily from others, although some marginal lands can be in a transition stage towards forests. However, the only conceptual problem was the boundary between forests and peatlands (including mires). That can be drawn in different ways although as such the differences have only marginal impacts on classification.

The common forest definition, which includes all forested mires and peatland classified as productive or poorly productive forest land into forests, gives forest area to be as much as 76% of the land area. In this case the peatland ecosystems cover only open peatlands and makes not more than 7 % of land area. However, if only drained and transformed forest land mires are included into the concept of forest, it brings forest share down to 59 % and peatlands and mires up to 20% of land area. Finally, if all peatland and mires on (productive) forest land and poorly productive forest lands are added into peatland category it makes 29% and for forests consequently 50% (Saastamoinen et al 2013). Originally, before agricultural expansion and large scale drainage of peatlands for forestry, one third of Finland was covered by peatlands and mires.

Major part of agricultural lands are former forests. Agricultural areas cover now roughly 9 % and built up areas about 5 % of land area. The rest of land use is mainly composed of open (treeless) mineral fell areas and other specific areas (under an old title of “waste land of forestry”) mostly located in the northern part of the country. The open fells and other northern open areas compose their own distinct ecosystems. Their ecosystem services are numerous, and include, for example, reindeer forage, berries, game, open landscape, tourism, recreation and habitat for biota. These services demonstrate that the old title “waste land of forestry” is discriminating and needs to be renamed.

This Finnish experiment of adopting CICES confirmed that the fifth classification level (class type) brought by Version 4 was really needed. In fact, this study found that even an additional level (called here as *sub-class type*) would be instrumental. Some sample examples of this additional levels can be found in Tables 1a, 1b and 2). In the separated classification of the provisioning services of forests (Saastamoinen et al 2014b) this additional level allowed to organize wood and non-wood goods into hierarchic structures which makes the entities easier to govern. The aim of CICES to provide logical generic and hierarchic structure actually means, that the first three levels (section, division, group) are quite general and it is the fourth *class* level which in principle is the starting point to bring the identified ecosystem services into the system. This is also the recommendation given by CICES (Haynes-Young and Potchin 2013). Therefore additional levels help to make the classification more concrete and functional.

How CICES, for example, captures medicinal plants into its structures? One can see that (Table 1a) it is here found as one of the picked sub-class type examples in the Class (9) Fibres and materials from plants and animals (biota) for direct use and processing. In the original forest ecosystem service classification (Saastamoinen et al 2014b) the Class type carries the title Fibres and other materials from other forest plants (i.e. other than trees) and Medicinal plants is one of the five additional Sub-class types. Although it is located at the lowest level of an expanded CICES classification it still carries a collective title without offering room to the wild strawberries of Carl von Linné or any other species of medicinal plants. Detailed specifications must be connected in other ways.

On the other hand, this sub-class type of medicinal plants already is specific in the sense it concerns only forest plants, and is separate from medicinal substance found from trees (which are included into Sub-class types of ‘e Tree extracts’ and ‘d Other materials from trees’). Medicinal compounds and substances are also found from mushrooms and from animals. Class *Genetic materials from all biota* include material for pharmaceutical processes. Niches for medicinal plants and materials can also be located in the classifications of other ecosystems.

Table 1a. Examples of an expanded CICES –classification of ecosystem services in Finland: Provisioning and regulation & maintenance services (Saastamoinen et al 2014 a). Class numbers are used here to connect class-types and sub-class types to classes

SECTION	DIVISION	GROUP	CLASS	CLASS TYPE ( <i>Sub-class type = expansion</i> ) EXAMPLES! A=Agricultural F=Forest P=Peatland W=Water es.
Provisioning	Nutrition	Biomass	1 Cultivated plants & outputs 2 Domestic animals & outputs 3 Wild plants & mushrooms 4 Wild animals & outputs 5 Plants, algae in situ aquaculture 6 Animals from in situ aquaculture	A: 1 Grains Fruits ( <i>Apples</i> ) 2 :Meat production ( <i>Cattle</i> ) W: 4 Wild fish Aquaculture sp.( <i>Rainbow trout</i> ) F: 3 Wild berries 4 Deer ( <i>Moose</i> ) 3 Mushrooms ( <i>Boletus</i> ) P: 3 Peatland berries ( <i>Cloudberry</i> )
		Water	7 Surface water –drinking 8 Ground water –drinking	W:7 Lakes Rivers F: 8 Groundwater ( <i>Eskers</i> ) Springs
	Materials	Biomass, Fibres	9 Fibres and materials from plants and animals for direct use and processing. 10 Materials from plants, algae and animals for agricultural use 11 Genetic materials from all biota	F: 9 Wood ( <i>Industrial</i> ) Other plants ( <i>Medicinal</i> ) 11 Tree genetics ( <i>Birch genetics</i> ) A: 9 Cultivated fibres Fodder Wool P: 10 Growth peat
		Water	12 Surface water non-drinking 13 Ground water non-drinking	W:12 Lakes Rivers Ponds ( <i>Agriculture</i> ) F: 13 Ground water ( <i>Industry</i> )
	Energy	Biomass-based energy sources	14 Plant-based resources 15 Animal based resources	F: 14 Energy wood ( <i>Stumps</i> ) P: 14 Peat A: Agricultural residuals
		Mechanical energy	16 Animal based energy	A: 16 Physical labor provided by animals ( <i>A: Horse A/F: Reindeer</i> )
Regulation & maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	17 Bio-remediation by biota 18 Filtration, sequestration, storage, accumulation by biota	F: 17 Trees ( <i>Willow</i> ) Other plants W: 18 Plants and animals of lakes and rivers
		Mediation by ecosystems	19 Filtration/sequestration /storage /accumulation of harmful materials by ecosystems 20 Dilution by atmosphere, freshwater and marine eco-systems 21 Mediation of smell/ noise/visual impacts	F: 19 Filtration and absorption of impurities of atmosphere ( <i>Trees</i> ) W: 20 Dilution of effluents in waters ( <i>Water plants and micro-organisms</i> ) F: 21 Shelter zones ( <i>Industrial areas</i> )
	Mediation of flows	Mass flows	22 Mass stabilization and control of erosion 23 Buffering and attenuation of mass flows	F: 22 Water erosion ( <i>Forest vegetation</i> ) 23 Forest buffer against mass flows
		Liquid flows	24 Hydrological cycle and water flow maintenance 25 Flood protection	F/W/P: 24 Effects of forests and other ecosystems ( <i>Water storage and evaporation</i> ) F: 25 Forests equalize water flow (Slow snow melting)

		Gaseous / air flows	26 Storm protection Ventilation and transpiration	27	F: 26 Coastal and archipelago protection F:27 Control of ventilation and temperature differences
Maintenance of physical, chemical and biological conditions		Lifecycle maintenance, habitat and gene pool protection	28 Pollination and seed dispersal 29 Maintaining nursery populations and habitats		F/P/A: 28 Pollinator populations 29 Distribution and linkages of ecosystems ( <i>Forest corridors</i> )
		Pest and disease control	30 Pest control control	31 Disease	F: 30 Biological prevention of forest pests ( <i>parasites</i> )
		Soil formation and composition	32 Weathering processes 33 Decomposition and fixing processes		F:33 Nitrogen fixing ( <i>Alder</i> )
		Water conditions	34 Chemical conditions of freshwaters 35 Chemical conditions of salt waters		W: 34 Oxidation of waters ( <i>micro-organisms in lakes</i> )
		Atmospheric composition and climate regulation	36 Global climate regulation by reduction of greenhouse gas concentrations 37 Micro and regional climate regulation		F: 36 Carbon binding ( <i>Trees</i> ) 37 Micro climate regulation (Forests)

Table 1b. Examples on the expanded CICES –classification of the ecosystem services in Finland: Cultural services (Saastamoinen et al 2014 a,b)

SECTION	DIVISION	GROUP	CLASS	CLASS-TYPE ( <i>Sub-class-type = expansion</i> ) EXAMPLES! A=Agricultural F=Forest P=Peatland W=Water ecosystems
Cultural services	Physical and intellectual interactions with ecosystems and land/seascapes [environmental settings]	Physical and experiential interactions	38 Physical recreational use of ecosystems and environments 39 Experiential use of plants, animals, ecosystems and environments in-situ	F: 38 Weekend recreation ( <i>Hiking</i> ) P:39 Observation of birds and animals ( <i>Bird towers in peatlands</i> )
		Intellectual and representational interactions	40 Scientific 42 Heritage, cultural 44 Aesthetic	F/A/P:40 Experimental areas F: 41 School forests F: 42 National historic places ( <i>Archeological</i> ) F:43 Nature films ( <i>Forest focus</i> ) F/W: National landscapes ( <i>Forest-water combination</i> )
	Spiritual, symbolic & other interactions with ecosystems and land/seascapes	Spiritual and/or emblematic	45 Symbolic religious	W/P: 45 Symbolic animals ( <i>Swan</i> ) F: 46 Places ( <i>forest graveyard</i> )
		Other cultural outputs	47 Existence	W: 47 Endangered animals ( <i>Saimaa ringed sea</i> ) F/P/W : 48 Nature conservation areas ( <i>Strict nature reserves</i> )

Examples of cultural services are found in Table 1b. These concise examples of Class types and Sub-class types do not make justice to CICES, which offers very wide scope into the cultural ecosystem services. Nearly everything under the extensive concept ‘culture’ which is related to the meanings and values of living nature can be included into these broad classes.

This is related to the important features of CICES of having generic approach and hierarchical structures, which allow several ways to identify systematically and without leakages all ecosystem goods and services – those already known and identified and those yet to be discovered. The approach illustrated in these examples to apply CICES is not the only possible. Experiences from experimental classifications will guide to find the best practices.

It has not been possible to present any of the full tables of integrated ecosystem services classification here but only demonstrate the general structure of the CICES and share some examples and experiences how it has been applied in the boreal context of Finland.

The decision to apply CICES as the classification framework seems to be a right one. Although CICES – based ecosystem service classifications at national level have so far published only in Belgium (Turkelboom et al 2013) it has been recommended that the countries of the European Union should use it in their national development of ecosystem service accounts (Maes et al 2013).

The observations done here are related to the attempt to bring first time in Finland the services of four major ecosystem into an integrated classification. It is also first time when CICES has been applied to the boreal ecosystem services.

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# Creating market for biodiversity by using habitat banking: preliminary assessment of applicability to Finland

Kniivilä, M.<sup>1</sup>, Kosenius, A.-K.<sup>1</sup>, Horne, P.<sup>1</sup>

<sup>1</sup> Pellervo Economic Research (PTT), Eerikinkatu 28 A, 00180 Helsinki, Finland, [firstname.lastname@ptt.fi](mailto:firstname.lastname@ptt.fi)

## Abstract

The aim of this study is to make a preliminary assessment of the applicability of habitat banking in Finland. The pros and cons of the mechanism as well as the most essential aspects from the Finnish perspective are assessed. The study concludes that habitat banking is one of the mechanisms which could be used in Finland to prevent or slow down the degradation of biodiversity. The mechanism includes ecological and economic risks, and thus the possible implementation in Finland should be preceded by a careful and relatively long-lasting piloting phase. Habitat banking could be used as a mechanism to compensate direct or indirect ecological harms caused to conservation areas e.g. by large scale infrastructural development projects or to compensate negative impacts of peat production. Furthermore, it could be used to compensate harms caused by large-scale development projects to other sites with specific ecological importance. However, the application of the mechanism should be carefully defined and restricted so that compensation demand would not lead to the hindering of ordinary economic activity.

**Keywords:** Habitat banking, Ecological compensation, Biodiversity, Ecosystem services, Market-based instruments

## Background and the aims of the study

The EU 2020 Biodiversity Strategy seeks to ensure no net loss (NNL) of biodiversity and ecosystem services. Loss of biodiversity is caused by many factors, e.g. by changes in land use including construction of infrastructure. At EU level one of the key instruments in securing biodiversity against this pressure are the Habitats and Bird Directives and Natura 2000 network. According to the Habitats Directive development projects which weaken the values of Natura 2000 network cannot be authorized. Only in some cases a permit can be granted, but compensation of the lost nature values is then required. Apart from the Habitats Directive at EU level there is no wider-scale demand for compensation.

One possible mechanism for achieving the target of no net loss is a wider use of compensation mechanisms. However, both in policy and science forums the usability of compensation has been discussed and questioned. It has been debated if nature values in general can be compensated, how effective earlier compensation measures have been and if the use of compensation would more likely lead to giving “license to trash” than to its original aim, i.e. preservation and increase of nature values.

In Finland legislation requires avoidance and minimization of losses to nature. In large-scale projects possible measures aiming to avoidance and minimization are examined in the environmental impact assessment (EIA) process. The legislation does not, however, enable the use of ecological compensation in permit procedures. Requirements for compensation are included only into few statutes.

The aim of this study is to make a preliminary assessment of the applicability of habitat banking in Finland. Habitat banking is an offsetting mechanism, which has been used for a long time e.g. in the USA and Australia. Several European countries use some compensation mechanisms, but habitat banking is widely used only in Germany. In this study the pros and cons of the mechanism as well as the most essential aspects from the Finnish perspective are assessed and recommendations for the

future actions are given. The paper is based on the report prepared for the Finnish Ministry of the Environment (Kniivilä et al. 2014).

## 1. What are biodiversity offsetting and habitat banking?

Ecological compensation must be considered in the context of the “mitigation hierarchy”. This means that compensation should be preceded by prevention and mitigation of negative impacts and used only as a final measure to compensate remaining negative impacts, if proceeding with the development project is considered necessary. The key aim is to ensure that the overall state of biodiversity remains unchanged or improves. As the term “compensation” is somewhat vaguely used and does not always include the idea of no net loss, the term biodiversity offsetting is often used instead. Biodiversity offsets are formalized arrangements for delivering compensation in terms of ecological values to increase biodiversity values or at least to achieve no net loss (ICF GHK 2013). Key principle in compensation is that there are “no go areas”, i.e. areas the nature values of which are so valuable that they have to be kept intact (see e.g. OECD 2013, ICMC IUCN 2012).

The Business and Biodiversity Offsets Programme (BBOP) has created a guidance of the best practices for the establishers of biodiversity offsets (BBOP 2009a and b, BBOP 2012). The criteria have been created in cooperation with significant amount of international organizations, governments and private companies. BBOP defines biodiversity offsets as follows:

*“Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from development plans or projects after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people’s use and cultural values associated with biodiversity.”* (ICMM IUCN 2012, BBOP 2012).

Offsetting mainly takes the form of measures to restore, rehabilitate, create or preserve habitats (Commissariat général... 2012). In many countries several of these measures are used and the choice of the measure depends on the circumstances. There are three different mechanisms, which are used to implement compensation (e.g. OECD 2013):

One-off approach: once adverse impacts have been evaluated, the biodiversity offset is carried out by the developer or by a subcontractor.

In-lieu arrangement: a government agency stipulates a fee that a developer has to pay to a third party, to compensate for residual biodiversity impacts.

Habitat banking/Biobanking etc.: once adverse impacts are evaluated, the developer can purchase offsets directly from already existing public or private habitat bank. The price of the credits is often determined in the market.

Finding areas which could compensate lost biodiversity values or ecosystem services is not easy. To fully compensate the loss, they should have at least potential for creation of similar nature values than is lost, be located close enough, be available to be used as a compensation area and bring additional value to existing conservation network. The possibly long time for development of nature values and the associated risks pose further challenges.

## 2. Habitat banking in the USA

In the USA there are two different compensation programs: conservation banking and wetland banking. Wetland banking is based on Clean Water Act of 1972. The use of conservation banking was begun in mid-1990s. In both mechanisms the developers whose actions are causing damage to nature are obliged by law to compensate the damage. This can be done e.g. by buying credits from habitat banks (conservation or wetland banks).

Habitat banks are sites where resources (e.g. certain habitat type or species) are restored, established and/or preserved (for perpetuity). The aim is to provide compensatory mitigation for impacts of development projects that lead to biodiversity loss elsewhere. The habitat bank sells credits to developers who are obligated to provide compensation (figure 1). The price of credits is often determined by supply and demand. The seller of the credits is the owner of land with biodiversity values (e.g. private landowner, companies, state) and credits are bought by the developers (e.g. companies, state) whose activities harm valuable features of nature. Authorities define rules of habitat banking, monitor implementation and define type, number and release of credits.

The unit of trading is normally a given acreage of strictly defined habitat. Sometimes, instead of acreage, the unit can be e.g. a nesting pair of an endangered bird species or a combination of the size of the area and species composition. For wetlands, functional value of the area and its size have major importance ([www.ecosystemmarketplace.com](http://www.ecosystemmarketplace.com)). In conservation banking credits are normally sold only after it can be proved that conservation has been successful. Thus, mere realization of the given conservation measures is not enough. This was not required in all agreements before.

The prices of sold credits vary depending on the characteristics of the habitat, costs of restoration and demand. Already at the beginning of the 2000s the highest prices per hectare were hundreds of thousands of US dollars (Bishop et al. 2008). The cheapest prices were at the same time about thousand US dollars per hectare (Bishop et al. 2008). According to Ecosystem Marketplace portal the average price of wetland credits was in 2008 about 30 000 US\$/ha. Prices vary between the US states and wetland types.

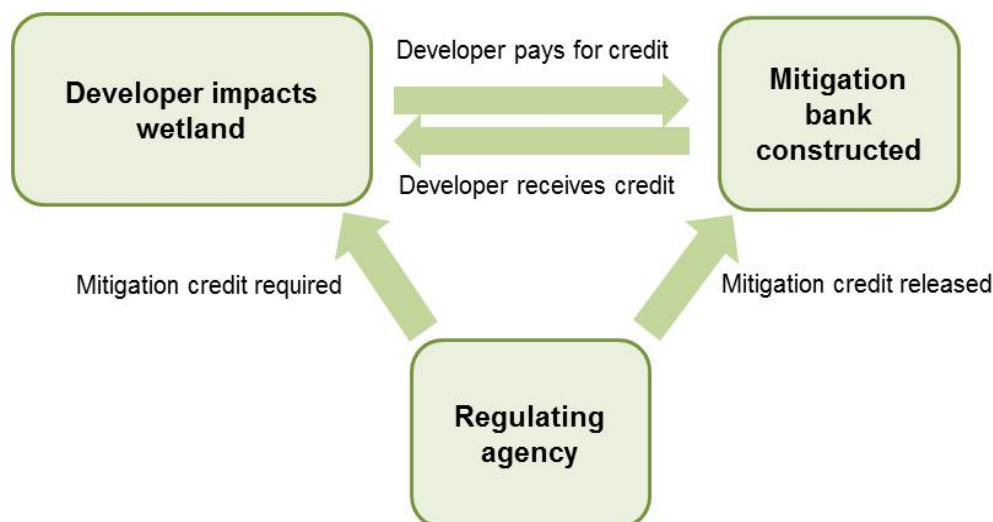


Figure 1. Wetland mitigation bank structure (Hook and Shadle 2013)

### Pros and cons of habitat banking

The use of ecological compensation has increased in Europe during the last few years. The aim has been that degraded biodiversity could be compensated by new, high-value areas. In practice, however, this has not always happened and in many cases outcome has been weak (Quickley and Harper 2005a, 2005b, Moilanen et al. 2009, Walker et al. 2009, Maron et al. 2012). One reason for failures has been too simple criteria for compensation, both in terms of replaced habitat and needed time (e.g. Overton et al. 2013). There have also been flaws in practical implementation and monitoring.

Bekessy et al. (2010) consider as problematic e.g. the time-lag related to restoration and the risks of failure. Also some compensation mechanisms allow the use as compensation areas sites which are already threatened and thus do not necessarily bring any additional ecological value to conservation network. Bekessy et al. (2010), however, consider the use of ecological compensation reasonable when it can be proved that compensation area has reached the biodiversity level required. According

to McKenney and Kiesecker (2010) mechanisms should be developed so that it is possible to evaluate the additional ecological value compensation areas are providing, likelihood to reach the ecological targets and time needed to create new ecological values.

If habitat banking is used as a compensation mechanism, it is important to assess the economic factors which impact on land-owners' and entrepreneurs' interest towards the mechanisms and to their willingness to create and use habitat banks. If landowners make their decisions on economic grounds, the net income from habitat banking should be higher than the net income from an alternative land use, e.g. forestry. Habitat banking as an economic activity includes risks related e.g. to ecological failures, regulation and time perspective (no certainty on demand and markets), all these impacting on expected net income.

From the society's point of view a significant factor is the consistency of habitat banking with the "Polluter pays" principle. Furthermore, by using habitat banking markets are created for non-market goods – biodiversity and ecosystem services. Creation of economic value for these goods should lead to more optimal use of resources from the society's point of view. Similarly, private landowners would benefit if they provide public goods in their property.

The use of compensation mechanisms includes ecological and economic risks and researchers' conclusions on the applicability of the mechanism are not unambiguous. However, if implementation is carried out by using good practices, the use of mechanism will lead to no net loss of biodiversity or net gain in biodiversity compared to situation with no compensation demanded.

### **Applicability of the mechanism to Finland**

Factors supporting the implementation of the mechanism in Finland:

- + Finland is a stable society with well-functioning institutes. This is a prerequisite for the success of habitat banking. Strict criteria, involvement of different parties and monitoring of activities are prerequisites for functioning of the mechanism.
- + Private forest owners could find habitat banking interesting as there are already positive experiences of the voluntary forest biodiversity conservation programme METSO.
- + Habitat banking might be interesting activity for Metsähallitus (organization governing state-owned forests) as the organization is already carrying out restoration activities. Habitat banking could also be an additional financing source for Metsähallitus. Furthermore, several Finnish companies find NNL principle interesting and relevant in their activities.<sup>8</sup>
- + There is a significant amount of experience of restoration activities in Finland.
- + Ecological knowledge and information needed for measuring sufficient compensation are well available in Finland.

Challenges and restricting factors:

- It can be challenging to find compensation sites which are ecologically valuable and locate close enough to development sites.
- There may not be enough voluntary demand. Changes in legislation might be needed.
- No certainty of sufficient demand and supply to guarantee economic viability.
- Development of the actual trading mechanism will take years.
- Development of ecological values in restoration sites will take long time.
- Private forest holdings in Finland are small. However, co-operation between forest owners would partly solve the problem.
- The role of state should be assessed. Could the state act as a seller and buyer of nature values and on the other hand also as a regulator of the mechanism? What would be the role of those restoration projects which are already under way?

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<sup>8</sup> See e.g. Finnish Business & Society ([www.fibsry.fi](http://www.fibsry.fi))

## Conclusions and recommendations

If ecological compensation will be used in Finland, compensation should be an option only if avoidance and minimization of loss are not enough to eliminate the problem, and carrying out the development project is still considered essential from the society's point of view.

As in Natura 2000 areas, the requirement of compensation could be considered also in other conservation areas where nature values are weakened. Ecological compensation could be an option also if biodiversity of existing conservation area is indirectly weakened e.g. because of a development project. This could include impacts of large-scale projects like mining and major road construction. Furthermore, the mechanism could be used in peat production by requiring ecological compensation for the use of peatlands of purely or nearly in natural state.

If the aim is to halt biodiversity degradation in accordance with the EU's "no net loss" target, requirement for compensation should include also other sites with specific ecological importance even if they locate outside conservation areas (e.g. habitats conserved by nature conservation act). Which nature values are considered exceptionally valuable and having specific ecological importance, should be explicitly determined, so that requirement for compensation would not lead to heavy bureaucracy and/or hindering and stagnating of conventional development.

Use of compensation would inevitably cause costs. If mechanism will be used in Finland, the developers causing the loss should be obliged, as far as possible and reasonable, to bear the costs. This would also encourage developers to seek alternative solutions to compensation (avoidance, minimization). This would also be in line with the EIA process.

Habitat banking mechanism is a market-based mechanism, but regulation is needed to support it. Use of habitat banking encourages landowners to produce voluntarily ecosystem services of social importance and it increases landowners' possibilities to make choices between different production lines. Use of habitat banking might be a way to move forward from the METSO programme and partly closer to market-based methods in nature conservation. Compensation mechanisms could also partly act as a financing mechanism of METSO.

Use of habitat banking is possible only if landowners/entrepreneurs find the mechanism interesting. The level of interest is dependent on many issues, e.g. clarity on the mechanism, stability and predictability of regulation, the level of demand and expected earnings, risks, and the availability of financing.

In addition to supply it would be important to assess also the level of demand. On what grounds the developers causing losses would be willing to take part in habitat banking? Is voluntary demand enough from the society's point of view or is obligatory compensation needed? Which of the compensation mechanisms or other mechanisms are the ones considered important from the society's viewpoint and what is the role of habitat banking among different mechanisms? In infrastructure projects the buyer of nature values would typically be the government. In more business oriented cases buyers would be private companies. Especially for companies working in international environment it is important that possible new practices in Finland would be in line with international practices. Even if habitat banking is a market-based mechanism, strong involvement of government is also needed. There are risks related to regulation, which impact on the success of habitat banking.

As for example restoration can fail due to ecological risks, the mechanism should be used in those habitats where the likelihood of success is high. Habitat banking could also be combined with the production of other ecosystem services, e.g. carbon sequestration or production of clean water. By producing several ecosystem services instead of one, habitat banking would most likely be more effective.

Habitat banking is one the mechanisms which could be used to prevent or slow down the degradation of biodiversity in Finland. However, the application of the mechanism should be carefully defined and

restricted so that compensation demand would not lead to the hindering of ordinary economic activity. The possible implementation of the mechanism in Finland should be preceded by a careful and relatively long-lasting piloting phase. In the piloting phase sites offered to METSO programme, but not accepted due to budget limits, could form a potential supply pool. However, the use of the mechanism should be examined also in other habitats, e.g. in traditional biotopes, which can be developed in a relatively short time, and in already partly restored mires. Interest of sellers and restrictions they set should be assessed. Similarly the needs and interest of buyers should be examined. Possible buyers in the piloting phase could be e.g. those companies which are already now carrying out compensation in their own activities. Furthermore, in the piloting phase a special emphasis should be given to the verification of the impacts of actions and to assessing the impacts on the costs of public authorities.

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# Rising carbon flux price and the paradoxes of forest-based reduction of atmospheric carbon stock: an extended summary

Colin Price

90 Farrar Road, Bangor, Gwynedd LL57 2DU, United Kingdom

**Keywords:** carbon price, atmospheric CO<sub>2</sub>, costs of climate change, lags

Several reasons can be given for why the price of a carbon flux, into or out of the atmosphere, might rise through time. On the demand side, it might be seen that emissions of CO<sub>2</sub> exert more damage as time advances, because a greater gross world product and a greater world population will then be adversely affected by climate change: thus there is an ever-increasing urgency to find means of mitigating net emissions. On the supply side, marginal abatement cost would be expected to rise, as the most cost-effective measures are taken up first, leaving progressively more costly measures as the only remaining options. Or price might be forced up in markets which are driven by governmental requirements to achieve targets for net emissions reduction. Indeed, such predictions of price rises are now embedded in the calculations mandated by some governments (DECC, 2009).

A rising carbon price might seem to mean that long-term investment in forestry would become progressively more attractive. That this is not so is due to the carbon flux profile of commercial forestry (Dewar and Cannell, 1992). A productive forest cycle entails both early sequestration of carbon *from* the atmosphere (at low prices) and late volatilisation *into* the atmosphere (at high prices). Hence a productive cycle might be deemed “loss-making” on its carbon account, even if, in every future time period, it appeared that its overall effect on atmospheric carbon stock would be not-detrimental. One suggestion is that this is simply an accounting loss: foresters “sell” carbon credits cheaply as the crop grows, and “buy” them back expensively as the fixed carbon is volatilised. Foresters may lose on the transactions: however, the world as a whole is benefited during the period when forests have a positive overall carbon balance, and thus forests exert a beneficial effect on reducing climate change.

On the other hand, carbon fluxes impose a real and probably rising cost on the world economy. The valuation of this cost is made complicated by lagged long-term change in physical conditions: Earth’s temperature adjusts only slowly towards the equilibrium indicated by CO<sub>2</sub> concentration, because of the thermal inertia of the oceans; the effect of CO<sub>2</sub> fluxes is mitigated over time by transactions of the gas between atmosphere, oceans and terrestrial ecosystems. These effects influence the ensuing economic costs of climate change, carrying the consequences into the distant future. Moreover, the lag in CO<sub>2</sub> transactions means that, in at least some future time periods, CO<sub>2</sub> concentration can be higher in the atmosphere *because* of the forestry project. Specimen calculations thus suggest that a forest production cycle which is overall carbon-neutral can indeed have a net detrimental effect on the world economy. While such a paradoxical result may be mitigated or reversed by discounting of carbon flux values, in practice there is debate about whether such values *should* be discounted – at the same rate as timber values, or even at all (Price, 1993).

Lengthening the rotation, often seen as highly beneficial for forestry’s carbon account, actually makes matters worse, because the carbon volatilisation phase then takes place at a time of even higher cost to the world economy.

Displacing high-embodied-carbon structural materials brings additional CO<sub>2</sub> mitigation at the time of harvesting, which is often presented as a very significant advantage of forestry seen in a wider context (Price and Willis, 2011). However, the slow decay of these substituting products and of biomass left in the forest again increases atmospheric CO<sub>2</sub> in the longer, higher-price term.

The inverse of the afforestation project is deforestation followed by natural regrowth. Because volatilisation of carbon now occurs early and sequestration occurs late, the result is also inverted: the carbon account is positive, the more so the longer forest regrowth takes.

Creating a normal forest structure, with equal areas in each age class, is one way of ensuring that at no future time are there any net emissions from the forest, and thus never any higher atmospheric CO<sub>2</sub> than would have existed without the forestry project. Then, the carbon account is always positive.

And yet a normal forest is composed of individual stands, each of which has a negative carbon account. The cause of this paradox is the customary time perspective of economists, and the attendant belief about what constitutes “the end of a cycle”. Carbon prices rising faster than the discount rate mean that, whatever reference point we take, there is always a more important time further in the future. In this context there is no evident “project end”: all stages of the forest cycle may be taken as equally representative of “the end of relevant time”. This being so, the terminal conditions are as likely to be those of a full-grown forest as those in which forest carbon has been mostly volatilised. In this perspective, the mean expected value of the carbon account for afforestation will be positive.

It is at moderate discount rates, which give emphasis to forestry’s timber revenues yet are likely to exceed the rate of carbon price rises, that forestry’s carbon accounts look most beneficial. Yet even such rates may be too high, and there are moves to reduce them for long-term projects such as forestry and climate change mitigation (UK Treasury, undated).

A full electronic version of the working document from which this summary is derived may be obtained from the author at [c.price@bangor.ac.uk](mailto:c.price@bangor.ac.uk).

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Author’s note: This paper was presented at the 2012 meeting of Scandinavian Society of Forest Economics and submitted for publication in the proceedings, but through some accident did not appear then.



# Institutional analysis of incentive schemes for ecosystem service provision – a comparative study across four European countries

Prokofieva, Irina<sup>1</sup>, Górriz, Elena<sup>1,2</sup>, Boon, Tove Enggrob<sup>3</sup>, Jacobsen, Jette Bredahl<sup>3</sup>, Naskali, Arto<sup>4</sup>, Ovaskainen, Ville<sup>4</sup>, Pettenella, Davide<sup>5</sup>, Secco, Laura<sup>5</sup>, Thorsen, Bo Jellesmark<sup>3</sup>, Tyrväinen, Liisa<sup>4</sup>, Vedel, Suzanne Elizabeth<sup>3</sup>

<sup>1</sup> Forest Sciences Center of Catalonia (CTFC), St. Pau Historic Site, St. Leopold Pavilion, c/St. Antoni Maria Claret 167, 08025 Barcelona, Spain. Email: irina.prokofieva@ctfc.es

<sup>2</sup> European Forest Institute – Mediterranean Regional Office (EFIMED), St. Pau Historic Site, St. Leopold Pavilion, c/St. Antoni Maria Claret 167, 08025 Barcelona, Spain. Email: elena.gorritz@efi.int

<sup>3</sup> University of Copenhagen, Denmark

<sup>4</sup> Finnish Forest Research Institute (Metla), Finland

<sup>5</sup> University of Padova, Italy

## Abstract

Incentive schemes and payments for ecosystem services attract increasing attention as a means for aligning the interests of landowners and society by remunerating forest owners for the goods and services their forests produce. As incentive schemes expand around the world, questions related to their institutional dimensions, as well as the role of different actors and existing institutions in their initiation, design and implementation, arise.

This paper seeks to gain an understanding of these issues by analysing a number of voluntary incentive schemes currently implemented in Denmark, Finland, Spain and Italy. The analysed schemes are predominantly aimed at enhancing biodiversity and improving recreation. One of the schemes is also related to preserving a variety of forest ecosystem services from forest fires.

The incentive schemes are studied following a framework for the institutional analysis of PES developed by Prokofieva and Górriz (Prokofieva, I. and Górriz, E. 2013: Institutional analysis of incentives for the provision of forest goods and services: an assessment of incentive schemes in Catalonia (North-East Spain), *Forest Policy and Economics*, 37, 104-114.). We focus on actor and institutional interactions and outcomes that are likely to result from schemes implementation to draw conclusions regarding the factors that influence the success and the durability of these schemes.

Our results show that the nature of the actors initiating the schemes has a paramount effect on their design and performance. Actors' networking capacity, consensus regarding the problem and its solution, and concordance of values are important determinants of schemes' success. Existing institutions (both at local and at an international level) on the one hand provide support for the new schemes, but on the other hand can also constraint their design and limit their applicability and implementation potential. Lack of integration with other sectoral policies creates tensions and weakens the performance of some schemes. The environmental effectiveness, economic efficiency and additionality of many schemes are highly questionable, although in some cases can be solvable by redesigning the schemes. Despite these serious shortcomings, in overall the experience with the schemes is perceived as positive with space for improvements. Yet, coordinated effort among actors at different levels is required to increase the overall governance quality of the incentive schemes.

**Keywords:** payments for ecosystem services, actor interactions, institutional interplay, instrument design, instrument performance

# Voluntary contracts for enhanced forest amenities: Forest owners' willingness to participate and compensation claims

Ville Ovaskainen<sup>1</sup>, Erkki Mäntymaa<sup>2</sup>, Liisa Tyrväinen<sup>3</sup>

<sup>1</sup> Finnish Forest Research Institute (Metla), P.O. Box 18, FI-01301 Vantaa, Finland, email: ville.ovaskainen@metla.fi

<sup>2</sup> Finnish Forest Research Institute (Metla), Rovaniemi, Finland, Email erkki.mantymaa@metla.fi

<sup>3</sup> Finnish Forest Research Institute (Metla), Rovaniemi, Finland, Email liisa.tyrvainen@metla.fi

## Abstract

Market-based mechanisms have received increasing attention as a new approach to balancing the provision of private and public forest benefits. A recent study in the Ruka-Kuusamo tourism area in northeastern Finland suggested that the tourists are willing to pay for selected improvements in the quality of recreation environments, in particular for enhanced landscape values and biodiversity, that can be achieved by adjustments in forest management and regeneration practices. Given such signals of a demand for enhanced forest amenities, the question is whether forest owners are willing to supply forest areas for enhanced tourism and recreational use and to commit to an accordingly adjusted management regime. This paper presents the key results of a choice experiment study of forest owners' willingness to participate and their compensation claims related to voluntary contracts for the provision of enhanced forest amenities in the Ruka-Kuusamo area. Considering the novelty of the idea, relatively many forest owners were generally interested in the suggested scheme and prepared to accept various obligations. More specifically, the willingness to participate was strongly dependent on the amount of compensation as well as on other terms of the contract, such as duration and harvesting restrictions. A 'threshold' compensation for commitment to a contract is required irrespective of any specific management restrictions. The largest marginal compensation claims were related to long contract durations and the stringent "no harvesting at all" restriction, the compensation claim for the latter being over three times higher than for "no regeneration cuttings". The marginal willingness to accept estimate for the prohibition of clearcutting was negative, suggesting that forest owners on average considered this change as beneficial.

**Keywords:** Environmental benefits, choice experiment method, payments for ecosystem services, market-based mechanisms, private forest owners, nature-based tourism, Ruka-Kuusamo area

The paper is based on research work done in the NEWFOREX project ([www.newforex.org](http://www.newforex.org))

# Heterogeneity in visitors' attitudes and preferences for forest amenities: Choice experiment models and multivariate methods

Erkki Mäntymaa<sup>1</sup>, Ville Ovaskainen<sup>2</sup>, Artti Juutinen<sup>3</sup>, Liisa Tyrväinen<sup>4</sup>

<sup>1</sup> Finnish Forest Research Institute (Metla), Rovaniemi, Finland, Email [erkki.mantymaa@metla.fi](mailto:erkki.mantymaa@metla.fi)

<sup>2</sup> Finnish Forest Research Institute (Metla), P.O. Box 18, FI-01301 Vantaa, Finland, Email [ville.ovaskainen@metla.fi](mailto:ville.ovaskainen@metla.fi)

<sup>3</sup> Finnish Forest Research Institute (Metla), Oulu; Thule Institute and Department of Economics, University of Oulu, Finland, Email [artti.juutinen@metla.fi](mailto:artti.juutinen@metla.fi)

<sup>4</sup> Finnish Forest Research Institute (Metla), Rovaniemi, Finland, Email [liisa.tyrvaainen@metla.fi](mailto:liisa.tyrvaainen@metla.fi)

## Abstract

Accounting for variation in consumers' tastes through customer segmentation is fundamental to marketing research. Similarly, preference heterogeneity is intrinsic in citizens' preferences for non-marketed environmental services. Failure to account for the heterogeneity can lead to confusing results in environmental valuation and to inefficient policy recommendations. This paper uses data from a choice experiment study conducted in the Ruka-Kuusamo nature tourism area in northeastern Finland to consider the heterogeneity in visitors' preferences for forest amenities. The survey, targeting domestic as well as foreign tourists and local visitors, focused on four environmental services of forests including landscape quality, outdoor routes, forest biodiversity, and carbon sequestration. We compare different approaches to dealing with taste heterogeneity and visitor segmentation. For a visible manifestation of preference heterogeneity, the visitors are first grouped by using principal components and cluster analysis on a set of attitudinal questions. Four interpretable principal components and four attitudinal groups are found. The manifestation of the latent preference heterogeneity in visitors' choice behaviour is then considered by interacting the attitude-based groups with the alternative specific attributes in the standard conditional logit model, and alternatively by using the latent class model. The interactions with the monetary attribute suggest significant differences in the willingness to pay for enhanced forest amenities across the attitude-based groups. The best fitting latent class model accordingly identifies three classes of visitors with distinctly different preferences and willingness to pay for specific amenities and for the mix of amenities. The paper concludes by discussing the policy implications of the findings.

**Keywords:** environmental services, choice experiment method, heterogeneous preferences, multivariate methods, conditional logit, latent class model, nature-based tourism

The paper is based on research work done in the NEWFOREX project ([www.newforex.org](http://www.newforex.org)).

# Assessing alternatives for recreational value trading

Teppo Hujala<sup>1</sup>, Janne-Perttu Rantonen<sup>2</sup>, Jukka Tikkanen<sup>2</sup>, Ville Ovaskainen<sup>1</sup>, Liisa Tyrväinen<sup>1</sup>

<sup>1</sup> Finnish Forest Research Institute (Metla), P.O. Box 18, FI-01301 Vantaa, Finland

<sup>2</sup> University of Eastern Finland, School of Forest Sciences, P.O. Box 111, FI-80101 Joensuu, Finland

## Abstract

Enhancing the provision of public goods from forests is attracting growing attention. In the Nordic Countries, open access to forests enables consuming diverse public goods and services regardless of land ownership. Demand for public goods is high especially in areas with high recreational pressure from local residents or active nature-based tourism. Often, however, the requirements of private goods production (mainly timber production) determine forest management measures. Therefore enhancing public good provision in private forests calls for new solutions. Recreational value trading is one of such mechanisms, but it has not yet been unanimously defined and transferred to wider practice.

To this end, this study reviewed recent literature on Payments for Ecosystem Services (PES) and determined an analytical multi-criteria assessment framework for comparing alternative features of recreational value trading schemes and their operability. This framework contains criteria of sustainability, interactivity, flexibility and equality, helping to consider e.g. the participating bodies; supervision, financing, and compensation mechanisms, as well as environmental justice aspects. The possible recreational value trading schemes may include e.g. following: 1) a private contract between two legal persons, 2) an intermediary organization and recreational value fund financed by tourist fees to manage the payments for recreation-oriented forest management, 3) an open online market system of recreational values, and 4) an additional real estate tax (or another comparable fee) for tourism enterprises, which is then directed for compensations when harvesting permissions are granted for recreationally vulnerable areas.

A case area of Ruka-Kuusamo, north-eastern Finland, provides the context for the study. Empirical data contains group interviews with local forest owners and nature-based tourism entrepreneurs as well as representatives from their lobby organizations, gathered in recreational value trading workshops (n=9). In particular, the themes discussed, following the criteria of the framework, aimed at finding answers to these two main research questions: 1) What kind of design of recreational value trading is desired in Ruka-Kuusamo? and 2) What kind of aspects need to be taken into account when establishing recreational value trading in Ruka-Kuusamo? The interviews were recorded, transcribed and analysed qualitatively, guided by the assessment framework and following a data-driven coding strategy.

It appeared that the interviewees favour a local-regional system for recreational value trading in which an intermediary organization and transparent rules are principal assets. In addition, a fund-based mechanism, active marketing, and fund-subsidised landscape-oriented forest planning connected to local certification seem to be important in Ruka-Kuusamo context. To conclude, recreational value trading may be operable in Ruka-Kuusamo area, and the following actions need to go further in specifying the fund and its operation and finding means to more nature-based entrepreneurs to perceive the benefits from participating in the scheme.

**Keywords:** public goods, nature-based tourism, multi-criteria assessment

# Who should carry the cost of ecosystem service provision? A pan-European citizens' view

Prokofieva, Irina<sup>1</sup>, Mavsar, Robert<sup>2</sup>, Bartczak, Anna<sup>3</sup>, Boon, Tove Enggrob<sup>4</sup>, Czajkowski, Mikolaj<sup>3</sup>, Giergiczny, Marek<sup>3</sup>, Jacobsen, Jette Bredahl<sup>4</sup>, Mäntymaa, Erkki<sup>5</sup>, Ovaskainen, Ville<sup>5</sup>, Pettenella, Davide<sup>6</sup>, Thorsen, Bo Jellesmark<sup>4</sup>, Tyrväinen, Liisa<sup>5</sup>, Vedel, Suzanne Elizabeth<sup>4</sup>, Vidale, Enrico<sup>6</sup>

<sup>1</sup> Forest Sciences Center of Catalonia (CTFC), Ctra. de St. Llorenç de Morunys, km 2, 25280 Solsona, Spain. Email: irina.prokofieva@ctfc.es

<sup>2</sup> European Forest Institute, Yliopistokatu 6, 80100 Joensuu, Finland. Email: robert.mavsar@efi.int

<sup>3</sup> University of Warsaw, Poland

<sup>4</sup> University of Copenhagen, Denmark

<sup>5</sup> Finnish Forest Research Institute (Metla), Finland

<sup>6</sup> University of Padova, Italy

## Abstract

The underlying notion of payments for environmental services is that beneficiaries of environmental services (directly or indirectly) financially support their provision by covering at least part of the costs landowners incur to generate them. This so-called “beneficiary-pay principle” is a widely accepted concept in theory, the legitimacy of which nevertheless has not yet been challenged in practice. In our study, we conducted an extensive survey in five European countries – Finland, Denmark, Poland, Italy and Spain – with the aim to explore citizens’ opinions of who should carry the costs of ecosystem services provision. The ecosystem services in question were biodiversity, recreation, carbon sequestration, water quality, and scenic beauty.

Our results show that the majority of respondents in all studied countries generally think that the costs of enhanced provision of ecosystem services shall be borne by the public administration, rather than by the direct beneficiaries of these services or by the forest owners. However, there is a clear tendency to accept that users shall pay for improved ecosystem service provision in case of local ecosystem services (such as e.g. water quality) or those that have a strong direct use component (e.g. recreation). Moreover, the respondents in generally accept that forest owners shall be compensated for the enhanced provision of ecosystem services, and only a small percentage of them thinks that forest owners should bear all the additional costs related to such provision.

**Keywords:** payments for ecosystem services, costs of provision, public policies

# Linking forest ecosystem services to corporate sustainability disclosure: a conceptual analysis

D'Amato, D. <sup>1\*</sup>, Li, N. <sup>2</sup>, Rekola, M. <sup>3</sup>, Toppinen, A. <sup>4</sup> and Lu, F-F. <sup>5</sup>

<sup>1</sup> University of Helsinki - Department of Forest Sciences, Latokartanonkaari 7, FI-00014, Helsinki, Finland, Email: dalia.damato@helsinki.fi

<sup>2</sup> University of Helsinki - Department of Forest Sciences, Latokartanonkaari 7, FI-00014, Helsinki, Finland, Email: ning.li@helsinki.fi

<sup>3</sup> University of Helsinki - Department of Forest Sciences, Latokartanonkaari 7, FI-00014, Helsinki, Finland, Email: mika.rekola@helsinki.fi

<sup>4</sup> University of Helsinki - Department of Forest Sciences, Latokartanonkaari 7, FI-00014, Helsinki, Finland, Email: anne.toppinen@helsinki.fi

<sup>5</sup> Nanjing Forestry University - College of Economics and Management, Nanjing Forestry University, 210037, Nanjing, P.R.China, Email: lvfei0417@163.com

## Abstract

Despite the increasing awareness of corporate dependencies and impacts on ecosystems, and related business risks and opportunities, scientific and corporate-based information on these issues is incomplete. Building on the conceptual understanding of impacts and dependencies of plantation-based forestry on ecosystem services, our paper aims at identifying existing and missing links between corporate sustainability disclosure and ecosystem services. In particular, our study includes a series of considerations regarding the catalytic role of the Global Reporting Initiative (GRI) indicators framework for integrating the ecosystem services approach into corporate sustainability management. Sustainability disclosure currently focuses on globally relevant key areas, such as forest products, water uptake, waste, carbon and pollutants emission and biodiversity impacts. However, some ecosystem services critical to the forest sector and possibly also to other natural resource-based industries are currently very poorly covered by corporate quantitative and financial indicators. The development of indicators is needed for assessing corporate sustainability in relation to, e.g. genetic resources, soil erosion and quality, natural hazards, biological control, land use and resource competition and cultural values embedded in forest ecosystems.

**Keywords:** Forest Ecosystem Service, Plantation forestry, Forest Industry, Corporate Sustainability, Global Reporting Initiative

## **International Forestry**

# Past and present profitability of deforestation of miombo woodlands considering CO<sub>2</sub> emissions in Maseyu village Tanzania

Meley Mekonen Araya<sup>1</sup> and Ole Hofstad<sup>1</sup>

<sup>1</sup> Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences, P.O. Box 5003, 1432, Ås, Norway

## Abstract

The miombo woodlands of Tanzania have been subjected to continuous deforestation due to mainly agricultural expansion. Understanding the linkage between deforestation and economic efficiency of the subsequent land use is important for better land use planning and management. *Ex-post* cost-benefit analysis (CBA) was used to examine the profitability of conversion of unmanaged miombo woodlands into cropland considering the environmental cost of the activity in terms of emissions of CO<sub>2</sub>. *Ex-ante* CBA was also used to compare profitability of keeping currently managed miombo woodland for the purpose of carbon sequestration with profitability of converting it into crop land. Net benefit (NB) of deforestation was calculated as the sum of agricultural rent and forest revenue during land conversion, minus cost of deforestation in terms of CO<sub>2</sub> emissions. NB of maintaining the managed woodland was based on returns from carbon sequestration. The NBs were discounted to provide an estimate of the net present value (NPV) of clearing and cropping, and maintaining the managed woodland. The value of CO<sub>2</sub> emissions and carbon sequestration was estimated by assuming different prices of CO<sub>2</sub> (USD ton<sup>-1</sup>). Data collected from 54 randomly selected households were used for estimation of current maize and charcoal production in the area. Data required for the estimation of profitability of historic deforestation and carbon densities of the current land uses in the area were gathered from various secondary sources. Deforestation history was obtained from land use and cover change since 1964 reported from the area. A simple growth model was also developed to describe the biomass development of the woodlands and thus to estimate the carbon sequestration rate. We found that deforestation of miombo woodlands in Maseyu village has been, and still is, profitable if environmental costs of deforestation are not accounted for. However, fairly low prices of CO<sub>2</sub> emissions would make deforestation unprofitable in the social analysis. At 10 % discount rate, the break-even price was USD 11 tCO<sub>2</sub>e<sup>-1</sup> for the historic deforestation that took place since 1964 in the common land. At the same discount rate, CO<sub>2</sub> prices higher than USD 6 tCO<sub>2</sub>e<sup>-1</sup> would turn future deforestation of the managed woodland in Kitulangalo Forest reserve (KFR) unprofitable. Incorporating other environmental costs of deforestation such as loss of biodiversity and emissions of other GHGs could potentially reduce the profitability of deforestation further, particularly deforestation of the woodlands in the forest reserve.

**Keywords:** Deforestation; Maize production; Charcoal production; CO<sub>2</sub> emissions; Carbon sequestration; CBA; Profitability

## Introduction

Small holder farmers in Sub-Saharan Africa clear woodland and forest for agriculture because it is profitable to them (Namaalwa et al. 2001). In spite of low crop prices, such deforestation is profitable because better paid employment opportunities are scarce. The opportunity cost of labor in the African countryside is very low. Deforestation has a number of environmental consequences that affect the welfare of many people negatively, most prominently loss of biodiversity and emissions of greenhouse gases (GHG), particularly CO<sub>2</sub>. The effects are of marginal interest to the farmers, however. Thus, deforestation that is profitable to individual agents has negative externalities that should be counted in the social analysis. GHG emission has a homogenous effect on climate (Vatn 2005), and has been traded (Linacre et al. 2011). Therefore, valuing the externality is possible.



Valuing loss of biodiversity is more difficult since it depends on the specific biological loss and the effects it may have on various groups of people. Biodiversity protection has also been traded to a lesser extent (Walker et al. 2009). We analyzed social profitability of deforestation of miombo woodlands in Tanzania considering CO<sub>2</sub> emissions but not biodiversity loss. Understanding the linkage between deforestation and economic efficiency of the subsequent land use is important for better land use planning and management.

Miombo woodland, a collective name for woodlands dominated by species of the genera *Brachystegia*, *Julbernardia*, and *Isoberlinia*, is a common vegetation type in large parts of sub-Saharan Africa (Campbell 1996). The miombo region covers an estimated 2.4 million km<sup>2</sup> and supports the livelihoods of about 100 million rural and urban dwellers (Deweese et al. 2010). These woodlands cover about 36% of the total land area and about 90% of the forest and woodland ecosystems of Tanzania (Malimbwi et al. 2005). They have been declining at an average rate of about 1.06 % per year since the 1990s (FAO 2010), mainly due to agricultural expansion.

As an example of deforestation and agricultural expansion, we studied land-use of unmanaged woodland in the public land and managed woodland in Kitulangalo Forest Reserve (KFR) in Maseyu village in Morogoro region, eastern Tanzania. We undertook two investigations of social profitability of deforestation in this area – one *ex-post* cost-benefit analysis (CBA) of the deforestation that has actually taken place in the common land outside the forest reserve since 1964, and one *ex-ante* CBA of possible future deforestation within the reserve. The latter is motivated by the idea that some forest reserves might be degazetted in case crop production is highly profitable even when environmental costs of deforestation, in our case CO<sub>2</sub> emissions, are included in the analysis.

## Materials and Methods

### Study site

The study site, Maseyu village is located about 50 km east of Morogoro town along the Dar es Salaam-Morogoro highway (Figure 1). The village covers approximately 36,000 ha with about 2000 inhabitants. It comprises settlements (170 ha), crop lands (215 ha), open miombo woodlands (woodland with scattered cultivation) (7000 ha), village reserve (150 ha), a part of (about 70%) the KFR (1700 ha) and a part of the Wami-Mbiki wild animals management area (WMA) (27000 ha). The woodlands on public land are openly accessible to the surrounding community. WMA is a community-based conservation area that was established in 1999. The WMA covers an area of approximately 4,200 km<sup>2</sup> and is surrounded by 24 villages including Maseyu (Madulu 2005). The woodlands inside the WMA have been subjected to extensive tree cutting for charcoal production and agricultural expansion. The KFR was gazetted in 1955 (GN198 of 3/6/1955) (Malimbwi and Mugasha 2001) and covers an area of about 2,452 ha, including the semi-evergreen forests in the Kitulangalo hills (Luoga et al. 2004). The part of the reserve located in Maseyu is managed jointly by the central government and the village. The current management system has been practiced since 2000. Cultivation and wood harvesting is prohibited within the reserve, but limited crop production, charcoal production and timber harvesting takes place illegally. The climate of the area is sub-humid tropical, with mean annual rainfall of 900 mm. The mean annual temperature is 24°C (Luoga et al. 2000). The vegetation is generally characterized as open dry miombo woodland, with some semi-evergreen forest (Luoga et al. 2000). The dominant tree species of the woodland are mainly used for charcoal making. As in other parts of the country, agriculture is the major occupation of the inhabitants. About 80 % of the households depend on small scale crop production, about 10% depend on charcoal production and 5% depend on livestock keeping. The rest are engaged in other activities such as petty business and casual employment (Nduwamungu et al. 2008). Maize (*Zea mays* L.) is the most important crop in the village, accounting for about 85% of all the crops cultivated.

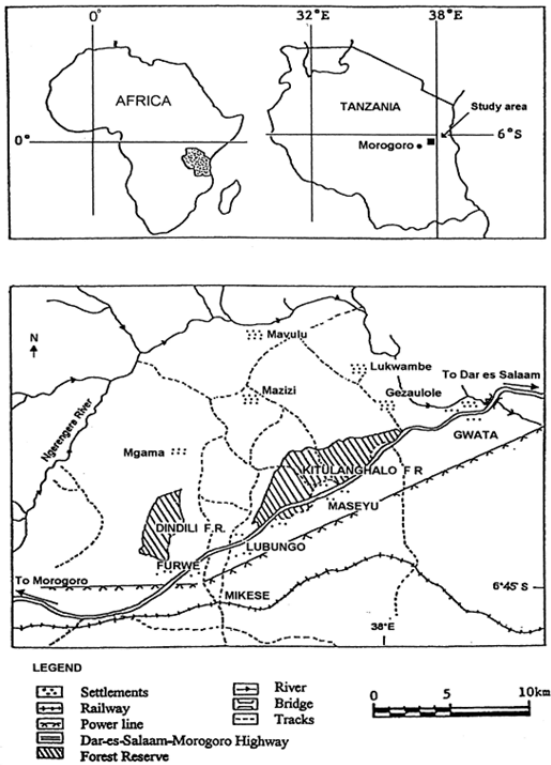


Figure 1. Location of the study site, source: Luoga et al. (2000)

## Data

Data on costs and revenues related to crop and charcoal production were collected from 54 randomly selected households using structured questionnaires. Additional information on prices of inputs, crop produce and charcoal were obtained from the local markets. Data on statistics of current (nominal) local (farm-gate) and global (US) price of maize, local price of charcoal, exchange rates and consumer price index (CPI) were gathered from secondary sources and are shown in Figures 2 and 3. Data on carbon densities in different pools of both the protected and unprotected woodlands, and the surrounding cultivated lands were also obtained from different published sources. Deforestation history was obtained from land use and cover change since 1964 reported from the area (Luoga et al. 2005).

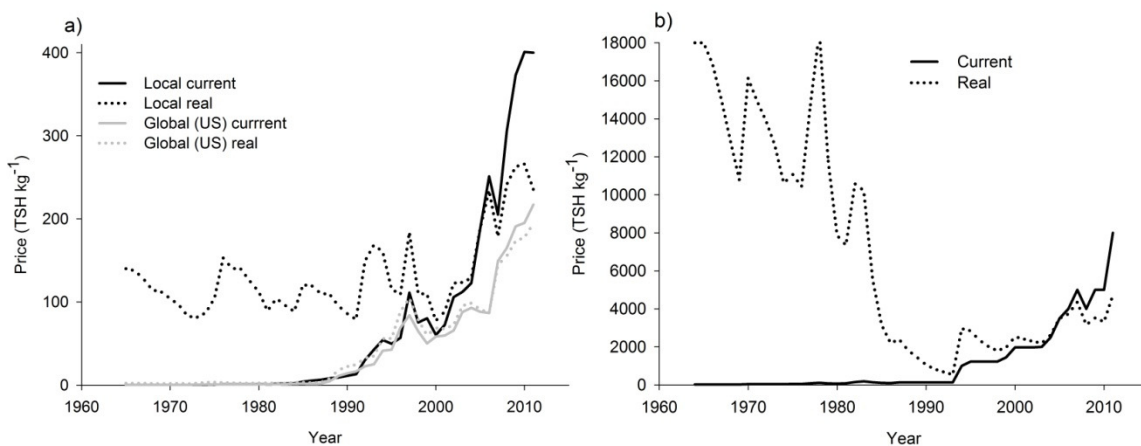


Figure 2. Current and real farm gate prices of maize in Tanzania and the USA from 1964 to 2011 (a), source: (Barreiro-Hurle 2012; Minot 2010; Morrissey & Leyaro 2007; Tapio-Biström 2001; USDA 2013) and current and real charcoal prices at the local market in Tanzania from 1964 to 2011 (b), source: (Hofstad & Sankhayan 1999; Malimbwi & Zahabu 2008)

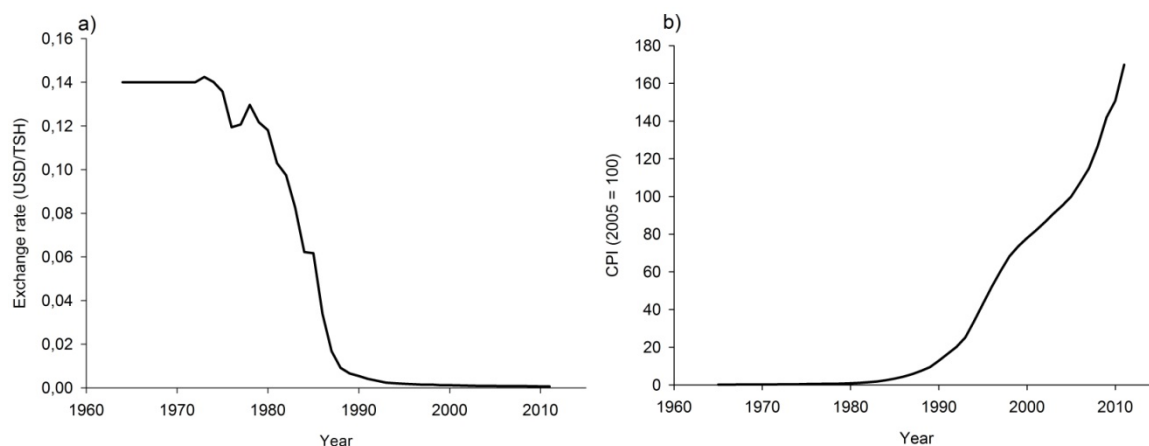


Figure 3. Tanzanian official exchange rates from 1964-2011 (a), source: (Index- Mundi 2011) and consumer price index (CPI) from 1964 to 2011 (b), source: (Index- Mundi 2011)

### Land use and cover change

The process of land-use change involves the expansion of crop land, extraction of wood mainly for charcoal making, and in some cases grazing of cattle. The woodlands on public land have been reduced from 13,558 ha in 1964 to 10,755 ha in 1982 and to 6,782 ha in 1996 (Luoga et al. 2005). From these figures, annual deforestation rates were estimated and the woodlands have been declining at a rate of 1.3% of the total area from 1964 to 1982 and at a rate of 3.24% of the total area from 1982 to 1996. The deforestation rate after 1996 in the public lands as well as the potential deforestation rate in the forest reserve was estimated as an average of the two rates (2.14%).

### Estimating carbon storage and sequestration

Data on above-ground biomass carbon and soil carbon of the woodlands were gathered from various sources (Munishi et al. 2010; Ryan et al. 2011; Shirima et al. 2011; Zahabu 2008). The below-ground biomass (carbon) was estimated as 20 % of the above-ground biomass. The soil carbon of croplands on deforested miombo woodlands was estimated as 60 % of soil carbon in miombo woodlands (Walker & Desanker 2004). The carbon estimate was multiplied by the conversion factor of 3.67 to obtain carbon dioxide equivalents (eCO<sub>2</sub>). The net CO<sub>2</sub> that will be emitted due to deforestation was calculated as the difference between the mean of the total carbon density of the woodlands and the carbon density under the cultivated land. Accordingly, the amount of carbon released into the atmosphere because of land conversion ranges from 35 t ha<sup>-1</sup> (128 teCO<sub>2</sub> ha<sup>-1</sup>) from the woodland on public land to 55 t ha<sup>-1</sup> (202 teCO<sub>2</sub> ha<sup>-1</sup>) from the woodland in the forest reserve. In the periods from 1964 to 1982, the amount of carbon stock of the woodlands on public land is assumed to be the same as the carbon stock of the woodlands in the forest reserve.

The amount of carbon sequestered by the woodland depends on the growth rate of the vegetation. Therefore, we developed a simple growth model, Verhulst (1838) equation (Figure 4a.) to describe the development of biomass of the woodland. The equation relates the stock,  $S$ , and the increment,  $\dot{S}$ , of biomass in the woodland:  $\dot{S} = a S - b S^2$ , where  $a$  and  $b$  are positive constants. The necessary data used to estimate the equation were obtained by Ek (1994) from permanent sample plots in the KFR. The constants  $a$  and  $b$  were estimated by fitting a linear regression model. Observations and the developed growth function are shown in Figure 4a. We used fitted versus residual plot (a constant variance test) to evaluate the model and it showed no bias and a constant variance with p-value of 0.469. Starting with the current average biomass density of the forest reserve, 40 t ha<sup>-1</sup> (Zahabu 2008), and assuming no harvest or fire, the biomass density is predicted to grow for about 80 years until it reaches its maximum. However, Luoga et al. (2002) reported an annual wood removal of  $1.12 \pm 0.68 \text{ m}^3 \text{ ha}^{-1}$  from the reserve. Using a 0.85 conversion factor from volume (m<sup>3</sup>) of fresh wood to biomass (ton) (Malimbwi et al. 1994), this corresponds to  $0.95 \pm 0.578 \text{ t ha}^{-1} \text{ yr}^{-1}$ . Under normal circumstances fires occur in miombo woodlands every dry season. Since observations on plots

affected by fire were excluded from our material, fire was considered afterwards. Barbosa et al. (1999) found that the average probability that a plot in wetter Zambezan woodland miombo burns in a particular year is approximately 37 %. Ryan and Williams (2011) reported that 5-6 % of live trees (dbh>5cm) were killed in fires in miombo woodland. By multiplying 0.37 by 0.05 we find that predicted biomass should be reduced by 1.85% when fire is considered. In the final analysis of biomass development in KFR we considered biomass reduction due to both fire and the illegal harvest. We assumed the illegal harvest as well as fire to be constant in all future (Figure 4b.).

### Estimating benefits and costs of deforestation, crop cultivation and woodland preservation for carbon sequestration

The benefit items of deforestation (clearing and cropping) are crop produce and wood obtained during land conversion. Deforestation also involves cost of land clearing and environmental costs such as loss of biodiversity and emissions of GHGs. The type of environmental cost of deforestation considered in this study is only CO<sub>2</sub> emissions. The deforested land is assumed to be used for the production of maize, the major crop type cultivated in the village. Since application of commercial fertilizers is very limited in the study area, the only input cost considered in relation to maize production is the cost of seed. Most of the sample households depend on family members for labor and opportunity cost of labor in the area is nearly zero. Hence, the cost of labor required for different activities during the production process is not considered in the analysis. The median yield of maize estimated from the household survey data was 620 kg ha<sup>-1</sup> and the average farm-gate price of maize in 2011 was 400 TSH kg<sup>-1</sup>. Farm-gate price of maize in the USA were considered as an approximation of global price of maize.

Wood obtained during clearing is assumed to be used for charcoal production. The current average standing volumes of the woodlands on public land and the woodlands in the KFR are 14 m<sup>3</sup> ha<sup>-1</sup> and 65 m<sup>3</sup> ha<sup>-1</sup>, respectively (Zahabu 2008). Tree species used for charcoal making represent 40 % of the standing volume and one m<sup>3</sup> of wood yields 4.3 bags of charcoal (56 kg bag<sup>-1</sup>). The labor required to produce one bag of charcoal is 2.3 man-days (Hofstad 1997). The average price of a bag of charcoal in 2011 was 8000 TSH at the kiln site and 10000 TSH at the road side.

The only benefit item of maintaining the protected woodlands is considered to be carbon sequestration. Currently, there is no cost involved related to maintaining or patrolling the forest reserve. Illegal harvest and fire are expected to continue (Figure 4b). Hence, there is no cost of management included in this study. Value of a ton of CO<sub>2</sub>e emissions and carbon sequestration was estimated by assuming different prices of CO<sub>2</sub> (USD/ton).

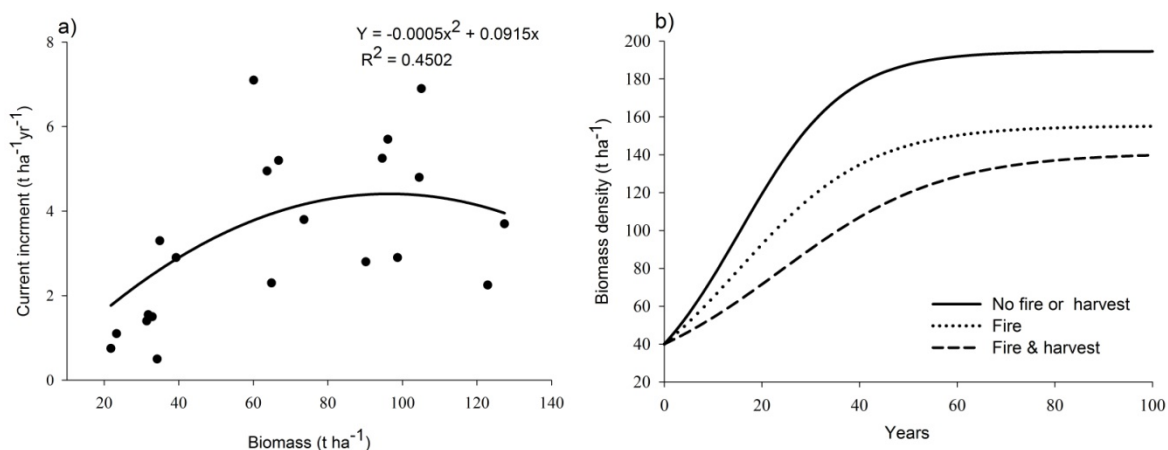


Figure 4. Observations of current increment and biomass density in KFR, with an estimated Verhulst growth function (a), and development of biomass density in KFR without fire or harvest, with fire alone, and with both fire and constant harvest of 0.95 t ha<sup>-1</sup>yr<sup>-1</sup> (b)

## Cost-Benefit Analysis (CBA)

In order to analyze the profitability of the deforestation that has actually taken place in the common land outside the forest reserve and possible future deforestation within the reserve, an *ex-post* and *ex-ante* CBA were undertaken, respectively. We estimated the financial returns to deforestation as the sum of agricultural rent and forest revenue during land conversion minus the environmental cost in terms of CO<sub>2</sub> emission. Net present value (NPV) of deforestation was used as a profitability criterion (Johansson & Löfgren 1985). The Cost-benefit flows were discounted to provide an estimate of the NPV of clearing and cropping, and maintaining the managed woodland, respectively. The discount rate used in this estimation is a real interest rate, estimated by adjusting the nominal discount rate (12 %) for inflation (6.4 %). The nominal discount rate is based on the rate of lending by the Bank of Tanzania as of January 2011 and the inflation rate is the inflation rate of all items for the period January 2010 to January 2011 (BOT 2011). Accordingly, we used a discount rate of 5.3%, but further investigated the effect of increasing this rate to 10% and reducing it to 2.5% through a sensitivity analysis. Other parameter considered in the sensitivity analysis was cost of labor. The opportunity cost of labor might change in the future and hence an increase in wage rate was examined in the analysis of potential deforestation. If real discount rates are to be used the prices of all inputs and outputs should also be in real terms. Hence, the real prices of maize as well as charcoal were calculated using the current (nominal prices) (Figure 2) and CPI (base year 2005) (Figure 3b). All values are equivalent to 2005's value. The global (USA) prices of maize were transformed to TSH by use of the 2005 exchange rate (Figure 3a).

## Results and Discussion

Figure 5 shows that clearing the woodland on public land has been profitable when a ton of CO<sub>2</sub> was valued at less than TSH 14,600 and 9,800 when local and global real prices of maize were considered, respectively. The values are equivalent to USD 13 and 9 respectively (Table 1), using an exchange rate as of 2005. The results of sensitivity analysis showed that increasing the discount rate from 5.3 % to 10 % reduced the break-even price of a ton of CO<sub>2</sub> to TSH 12,500 (USD 11) and TSH 9,100 (USD 8), respectively. Deforestation was less profitable using the US price of maize as compared to Tanzanian price because the price in Tanzania was kept higher than world market prices early in the considered period. The high discount rate used in this study is within the range of the discount rates (8-15%) applied for agricultural projects in developing countries (Bond et al. 2010). Besides, given the level of poverty persisting in the miombo areas, a discount rate of 10 % per annum may be a reasonable assumption. Given the degraded state of woodlands in the common land in 1964 the shift from woodland to cropland could have been profitable even when we consider the social cost of CO<sub>2</sub> emissions. The conclusion depends on which price of CO<sub>2</sub> is considered realistic. The present low price in the EU market may be a result of the high volume of emission quotas distributed when the market was established (McGrath 2013; Zhang & Wei 2010). The reduction of biodiversity and other important ecosystem services following deforestation was not included in our analysis, however. This negative externality could have reduced profitability of deforestation significantly. On the study of the economics of deforestation in Ecuador, Wunder (2000) reported that the underlying cause of deforestation is that the natural forest provides less income than alternative land uses. He also suggested that considerable success in reducing deforestation can only be achieved when payments for global forest benefits are applied.

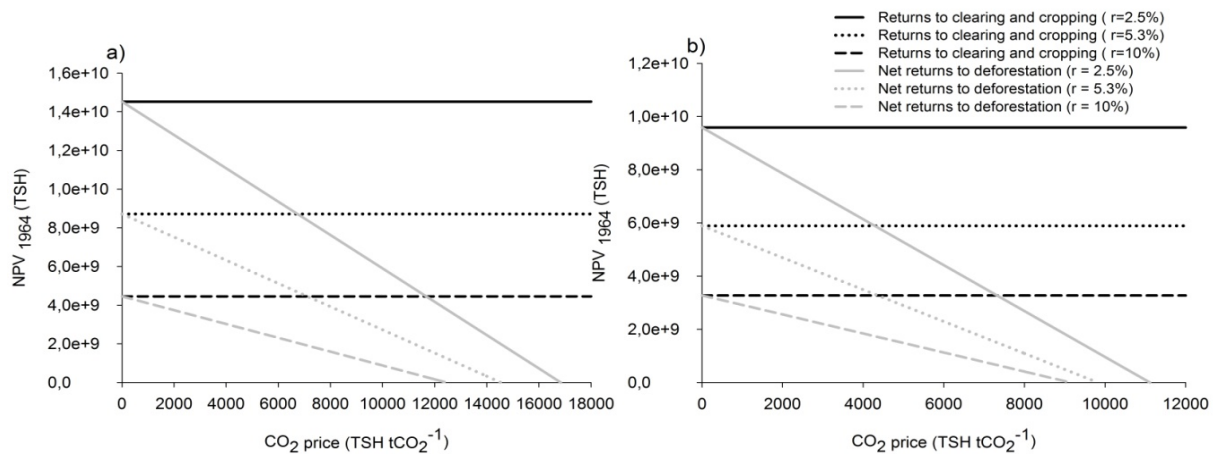


Figure 5. Social profitability of deforestation estimated using local price of maize (a) and global (USA) price of maize (b)

Table 1. Break-even prices of CO<sub>2</sub> emission (USD tCO<sub>2</sub>e<sup>-1</sup>) for the historic deforestation of woodlands in the common land

Price of maize	Discount rate (real)		
	2.5%	5.3 %	10 %
Local price	15	13	11
US price	10	9	8

Table 2 shows that maintaining the protected woodland can be more profitable than the potential benefits of deforestation at a price of CO<sub>2</sub> higher than USD 9.5. Increasing the discount rate from 5.3 % to 10 % made managing the reserve profitable at a price of CO<sub>2</sub> higher than USD 6. Reducing the discount rate from 5.3 % to 2.5 % on the other hand increased the price of CO<sub>2</sub> where managing the woodland becomes profitable into higher than 18 USD ton<sup>-1</sup>. When wage rate was increased from zero to the minimum wage rate of 2,692 TSH manday<sup>-1</sup>, keeping the forest reserve for carbon sequestration became profitable at a price of CO<sub>2</sub> higher than USD 11.5, 6 and 3.5 for interest rates of 2.5%, 5.3% and 10%, respectively (Table 2). This implies that better employment opportunities in the area would make deforestation of the woodland in the reserve less profitable.

The miombo ecology is still relatively well protected inside the reserve. Future deforestation of the protected forest reserve does not seem to be a profitable land-use alternative from the perspective of the global community. Emission of CO<sub>2</sub> and lost opportunities to sequester additional quantities of CO<sub>2</sub> from the atmosphere make this management option non-profitable at fairly low values per ton of CO<sub>2</sub> emission. However, from the perspective of the local community, conversion of the reserve into crop land is a profitable activity. The similar conclusion in the *ex-ante* analysis of the reserve and the *ex-post* analysis of the common land is explained mainly by the fact that biomass density increment in the reserve is very low if the illegal wood harvesting and fire remain.

It is not possible to generalize the results from Maseyu to all of Tanzania, much less so to the whole of Sub-Saharan Africa. However, our results support the intuitive general insight that forests with low biomass density may be allocated to crop production while forests with higher biomass density and a potential for further biomass accumulation should be protected (Kaimowitz et al. 1998). This conclusion presupposes a certain productivity of land in crop production. One should keep in mind that this study did not investigate whether restoration of degraded woodland or establishment of forest plantations on such land are profitable means of climate change mitigation.

Table 2. Break-even price of GHG emission (USD/tCO<sub>2</sub>e) for protection of KFR

Wage rate	Discount rate (real)		
	2.5 %	5.3 %	10 %
Zero	18	9.5	6
Minimum wage	11.5	6	3.5

## Conclusion

Deforestation of miombo woodlands in Maseyu village has been, and still is, profitable if environmental costs of deforestation are not accounted for. However, fairly low prices of CO<sub>2</sub> emissions would make deforestation unprofitable in the social analysis. At 10 % discount rate, depending on the prices of maize considered, this price ranged from USD 8-11 tCO<sub>2</sub>e<sup>-1</sup> for the historic deforestation that took place from 1964 in the common land. At the same discount rate, CO<sub>2</sub> prices higher than 3.5 - 6 USD tCO<sub>2</sub>e<sup>-1</sup>, depending on the wage rates applied, would turn future deforestation of the woodland in KFR unprofitable. The difference between the break-even price estimated using the *ex-post* analysis and *ex-ante* analysis is due to the fact that biomass density is higher inside the reserve than it was in the common land, and biomass density is likely to increase in spite of fire and illegal harvesting if the reserve is maintained. Lower discount rates would obviously lead to higher break-even prices of emissions. However, given the fact that the inhabitants in miombo areas prefer immediate consumption because of poverty, applying higher discount rate might be a reasonable assumption. Incorporating other environmental costs of deforestation such as loss of biodiversity and emissions of other GHGs could potentially reduce the profitability of deforestation further, particularly deforestation of the woodlands in the forest reserve.

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# Benefits of interrelationships between climate change mitigation and adaptation – a case study of replanting mangrove forests in Cambodia

Lea Ravnkilde Møller<sup>1</sup> and Jette Bredahl Jacobsen<sup>2</sup>

<sup>1</sup> PhD candidate at the UNEP Risoe Centre, DTU Management Engineering, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark

<sup>2</sup> Professor at the Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, Denmark

## Abstract

The paper demonstrates welfare benefits of climate change mitigation and adaptation as a joint response to climate changes using the theory of multiple-use forestry or joint production by Vincent and Binkley (1993). The production of two products is considered: product 1: climate change mitigation and product 2: climate change adaptation. The production possibilities frontier (PPF) summarises the production benefits of the two products. The case study of the paper is the replanting of mangrove forests in the coastal wetland areas of Peam Krasaob Wildlife Sanctuary in Cambodia. The benefits of climate change mitigation will be estimated on the basis of the amount of carbon sequestered in the replanted area. The benefits of climate change adaptation are the replanted area's ability to protect the local community from storms and sea level rise, including the co-benefits of enhanced productivity of economic activities in the area: tourism and fisheries. The theory used to calculate the adaptation benefits is the Expected Damage Function (EDF) (Barbier 2007). Here the benefit is the difference between the expected damage costs and the total amount of expected damage costs avoided.

The estimated benefits of climate change mitigation and adaptation are tested under different climate change scenarios, seeing as the impact and frequency of storms can have a significant effect on coastal wetland areas and the replanting of the mangrove forests and therefore also on the joint benefits of climate change mitigation and adaptation. The paper concludes that there are benefits in climate change mitigation and adaptation; hence, no extra investment needs to be initiated to identify such benefits.

# Comparing one-year recall and daily household records of livelihood activities

Helle Overgaard Larsen<sup>1</sup>, Thorsten Treue<sup>2</sup>, Yonika Ngaga<sup>3</sup>, George Kajembe<sup>4</sup>, Shabani Chamshama<sup>5</sup>, Henrik Meilby<sup>6</sup> and Ida Theilade<sup>7</sup>

<sup>1</sup> Department of Food and Resource Economics (IFRO), University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, hol@ifro.ku.dk

<sup>2</sup> IFRO, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, ttr@ifro.ku.dk

<sup>3</sup> Sokoine University of Agriculture, Morogoro, Tanzania, yngaga@yahoo.co.uk

<sup>4</sup> Sokoine University of Agriculture, Morogoro, Tanzania, kajembe@suanet.ac.tz

<sup>5</sup> Sokoine University of Agriculture, Morogoro, Tanzania, chamstz@yahoo.com

<sup>6</sup> IFRO, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, heme@ifro.ku.dk

<sup>7</sup> IFRO, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, idat@ifro.ku.dk

## Abstract

Rural livelihood studies in developing countries usually depend on household members' own recollection of their income-generating activities, including extraction of environmental products, yield of agricultural crops and livestock products, wage and casual labour income, and income from business activities. In this study we examine discrepancies between activities and associated incomes (cash and subsistence) reported by sample households through interviews conducted at the end of a one-year recall period and based on daily records of livelihood activities made by the same households throughout the entire year. The study is based on data from two villages in different parts of Tanzania. Differences between results obtained using the two data collection methods vary between activities and product categories but are in some cases considerable. This has important implications when such data are assumed to reflect the rural economic reality and thus used for policy formation and implementation.

**Keywords:** environmental income, household diary, one-year recall, rural livelihoods

## Unity in diversity

*Colin Price*

**Fresh** from the **intellectual** front, resuming dialogue as planned, not just from Scandinavian countries, swathes of forest-relevant researchers came from many a land. We came to put the world to rights, and offer others some polite suggestions from our own insights on work entrusted to their hand.

With Germany, the list begins not far beyond the border, to add to Northern origins – the Swedes, Norwegians, Danes and Finns (**not necessarily** in that order). With France and Italy and Spain Poland, Belgium and Ukraine, Brazil, the USA again, “abroad” gets ever broader.

Those from close, close to the hearts of those who met them long ago, and those who came from distant parts around the globe, to learn the arts that only Scandinavians know; the one from Wales who tried to sit, unnoticed, while these lines were written, and another one from Britain – though the English failed to show.

However pompous and unwise to make such compilation, this little batch of verses tries to codify and summarise the thoughts of every nation: what they showed and talked about – and if I missed your country out, please don't be shy, just give a shout: I'll fix it for the publication.

Nick Hanley launched us on the road of controversy yesterday with key results in colour code – the blue and green and red that showed, in diverse shades of grey; with wills or won'ts and cans or can'ts of farmers boosting birds and plants by ecosystem service grants designed the smartest way.

And then an enervating round  
of papers on four diverse themes,  
by one conviction firmly bound:–  
the answer other people found  
is seldom what it seems.  
No treatment is so complicated  
that it cannot be related  
to some worker's dedicated  
exploration of extremes.

Presenters in “Verandan” staged  
a drama wonderful to see.  
The normal controversies raged:  
if even- or uneven-aged  
gave higher NPV;  
if climate-change evaluation  
owners made, bore explanation;  
if products' differentiation  
made the optimal rotation  
longer than it used to be.

Participants in “Festvåningen”  
found what new research has shown us:  
how we might contrive to bring a new  
approach to harvesting engaged  
by private forest owners;  
young people's keen discrimination,  
wood supply negotiation,  
forest/mill collaboration,  
with information as a bonus.

Meanwhile, back in “Linnésalen”  
still incentive business  
occupied our minds and talents;  
what forest owners feel, on balance,  
proper compensation is,  
and what the willingness to pay.  
So ecosystem services,  
appropriately, closed the day

But what went on in “Aspen”, is  
... more than I can say.

Greg **AMakER** then made a major  
prospect based on Samuelson  
(whose paper still is hard to gauge,  
aright, since his came on the stage a  
-n epoch after Faustmann's one).  
*Do* crops' profits take a dive allied  
to chances of survival,  
or does the “bad” events' arrival  
give a thinning ... such as owners might have done?

We then dispersed to working groups  
according to preoccupations:  
the joys of jumping through the hoops  
for getting subsidies, the soups  
of EU regulations.

From Alps to Tropics, east to west,  
from optimal to second best,  
we ranged – yet common thoughts invest  
our common aspirations.

As for papers coming later,  
outputs yet to be revealed,  
we could decide to contemplate a  
longer run of same-old data,  
and better  $R^2$ s it may yield.  
But though consistency is fine,  
still, *I* would hope, we all incline  
to listen to another line  
of thinking, in another field.

For, though the specialties we chose d-  
iverge, tonight's the time for sinking  
diff-er-ences here exposed,  
since minds are opened up, not closed –  
unless by too much drinking.

Tomorrow is another day,  
when other people have their say,  
and new results for sure could sway  
our former ways of thinking.

An opportunity to grasp an-  
other viewpoint comes our way.

But what will come to pass in “Aspen”  
*still* is more than I can say.

## List of participants

### SSFE 2014

Name	Organization	Address	Email
Abildtrup, Jens	INRA	14 RUE GIRARDET 54042, NANCY CEDEX France	jens.abildtrup@nancy.inra.fr
Amacher, Gregory	Virginia Tech	304-D Cheatham Hall (0324) 24061, Blacksburg, VA United States	gamacher@vt.edu
Araya, Meley	Norwegian University of Life Sciences (NMBU)	Sørhellinga, Høgskoleveien 12 1430, Ås Norway	meley.araya@gmail.com
Bartczak, Anna	University of Warsaw	ul. Krakowskie Przed. 26/28, 00-926 , Warsaw Poland	bartczak@wne.uw.edu.pl
Berck, Peter	University of Gothenburg	Box 640 405 30 , Göteborg Sweden	pberck@berkeley.edu
Berghäll, Sami	Univ. of helsinki	Latokartanonkaari 7 b-house 5th. floor 00014 , UNIVERSITY OF HELSINKI Finland	sami.berghall@helsinki.fi
Bezyk, Yaroslav	Ukrainian National Forestry University	Sweden	slavikbezyk@gmail.com
Bostedt, Göran	Swedish University of Agricultural Sciences	Skogsmarksgränd 1 901 83, Umeå Sweden	Goran.Bostedt@slu.se
Brazee, Dick	University of Illinois	W-503 Turner Hall, 1102 S. Goodwin 61801, Urbana, Illinois United States	brazee@illinois.edu
Brege, Staffan	Linköping University	581 83 , Linköping Sweden	staffan.brege@liu.se
Burkhardt, Thomas	University of Koblenz	Universitätsstr. 1 D-56070 , Koblenz Germany	tburkha@uni-koblenz.de

Caurla, Sylvain	INRA	14 rue Girardet 54000, Nancy France	sylvain.caurla@nancy.inra.fr
Chomba, Susan	University of Copenhagen	Rolighedsvej 25 1958 Frb. C, Copenhagen Denmark	schomba@ifro.ku.dk
D'Amato, Dalia	University of Helsinki	Latokartanonkaari 7 00014, Helsinki Finland	dalia.damato@helsinki.fi
Doru-Leonard, Irmie	EU Reasearch		
Gong, Peichen	SLU, EFINORD	901 83 , Umeå Sweden	peichen.gong@slu.se
Górriz, Elena	Forest Sciences Center of Catalonia (CTFC)	Ctra St Llorenç de Morunys s/n 25280, Solsona Spain	elena.gorriz@ctfc.es
Guan, Zhijie	SLU	umea 90183, Umeå Sweden	zhijie.guan@163.com
Gustafsson, Åsa	Linnaeus University	Universtetsplats.1 35195 , Växjö Sweden	asa.gustafsson@lnu.se
Hanley, Nick	University of Stirling	FK9 4LA, Stirling, Scotland United Kingdom	n.d.hanley@stir.ac.uk
Harrinkari, Teemu	Finnish Forest Research Institute METLA	P.O. Box 18 FI-01301, Vantaa Finland	teemu.harrinkari@metla.fi
Hietala, Jyri	Pellervo Economic Research PTT	Eerikinkatu 28 A FI-00180 , Helsinki Finland	jyri.hietala@ptt.fi
Hoen, Hans Fredrik	Norwegian University of Life Sciences	PO Box 5003 N-1432, Ås Norway	hans.hoen@nmbu.no
Hujala, Teppo	Finnish Forest Research Institute (Metla)	P.O. Box 18 01301, VANTAA Finland	teppo.hujala@metla.fi
Hurmekoski, Elias	European Forest Institute	Yliopistokatu 6 80100, Joensuu Finland	elias.hurmekoski@efi.int

Hyytiä, Annika	University of Helsinki	00014 Helsingin yliopisto, Helsinki Finland	annika.hyytia@helsinki.fi
Jacobsen, Jette Bredahl	University of Copenhagen	Rolighedsvej 23 1958, Frederiksberg C Denmark	jbj@ifro.ku.dk
Jensen, Frank	University of Copenhagen	Rolighedsvej 23 1958, Frederiksberg C. Denmark	fje@ifro.ku.dk
Johansson, Jimmy	Linneaus University	Lückligs plats 1 35195, Växjö Sweden	jimmy.johansson@lnu.se
Kalnyk, Oleh	Ukrainian National Forestry University	Sweden	kalnyklviv@gmail.com
Kiljunen, Nuutti	Metsähallitus	Asemakatu 7 (PB 1058) 70101, Kuopio Finland	nuutti.kiljunen@metsa.fi
Kindler, Elisabeth	Göttingen University	Büsgenweg 3 37077 , Göttingen Germany	ekindle@gwdg.de
Kniivilä, Matleena	Pellervo Economic Research PTT	Eerikinkatu 28 A FI-00180, Helsinki Finland	matleena.kniivila@ptt.fi
Korhonen, Jaana	University of Helsinki	PI 27 00014, University of Helsinki Finland	jaana.e.korhonen@helsinki.fi
Kronholm, Thomas	SLU	Skogsmarksgränd 901 83 Umeå, Umeå Sweden	thomas.kronholm@slu.se
Kuusela, Olli-Pekka	MTT Agrifood Research Finland	Latokartanonkaari 9 FI-00790, Helsinki Finland	olli-pekka.kuusela@mtt.fi
Larsson, Magnus	Skogforsk, co SCA R&D Centre	Box 716 85121 , Sundsvall Sweden	magnus.larsson.skog@sca.com
Levet, Anne-Laure	FCBA	10 Avenue de St-Mandé 75012, Paris France	anne-laure.levet@fcba.fr
Lundhede, Thomas	University of Copenhagen	1958, Frederiksberg Denmark	thlu@ifro.ku.dk



Lähtinen, Katja	University of Helsinki	P.O. Box 27 (Latokartanonkaari 7) FI-00014 , University of Helsinki Finland	katja.lahtinen@helsinki.fi
Lönnstedt, Lars	Swedish University of Agricultural Sciences	Box 7060 75006, Uppsala Sweden	Lars.Lonnstedt@slu.se
Matthies, Brent	University of Helsinki	Latokartanonkaari 7 00014, Helsinki Finland	brent.matthies@helsinki.fi
Mattila, Osmo	University of Helsinki	P.O. Box 27 (Latokartanonkaari 7) 00014, University of Helsinki Finland	osmo.mattila@helsinki.fi
Mavsar, Robert	European Forest Institute	Yliopistokatu 6 80100, Joensuu Finland	robert.mavsar@efi.int
Meilby, Henrik	University of Copenhagen	Rolighedsvej 23 1958, Frederiksberg C Denmark	heme@ifro.ku.dk
Miettinen, Jenni	University of Helsinki	P.O. Box 27 (Latokartanonkaari 9) FI-00014 University of Helsinki, Helsinki Finland	jenni.miettinen@helsinki.fi
Mäntymaa, Erkki	MTT Agrifood Research Finland	Eteläranta 55 96300 , Rovaniemi Finland	erkki.mantymaa@mtt.fi
Møller, Lea Ravnkilde	DTU	UN-City, Marmorvej 51 2100, Copenhagen Denmark	leam@dtu.dk
Nord, Tomas	Linköpings Universitet	581 83 , Linköping Sweden	tomas.nord@liu.se
Nummelin, Tuomas	SLU/EFINORD/Metla	Skogsmarksgränd 901 83, Umeå Sweden	tuomas.nummelin@efi.int
Ovaskainen, Ville	Finnish Forest Research Institute (Metla)	P.O. Box 18 FI-01301 , Vantaa Finland	ville.ovaskainen@metla.fi
Pajuoja, Heikki	Metsäteho Oy	Vernissakatu 4 01300, Vantaa Finland	heikki.pajuoja@metsateho.fi

Pettenella, Davide	University of Padova	Via Università 16 35020, Legnaro PD Italy	davide.pettenella@unipd.it
Petucco, Claudio	INRA LEF	54042, NANCY CEDEX France	claudio.petucco@nancy.inra.fr
Pokela, Eveliina	CEPF - Confederation of European Forest Owners	Rue du Luxembourg 66 1000, Brussels Belgium	eveliina.pokela@cepf- eu.org
Price, Colin	Colin Price Free-lance Academic Services	90 Farrar Road LL57 2DU, Bangor, Gwynedd United Kingdom	c.price@bangor.ac.uk
Prokofieva, Irina	Forest Sciences Center of Catalonia	C/St. Antoni Maria Claret 167 08025, Barcelona Spain	irina.prokofieva@ctfc.es
Rekola, Mika	University of Helsinki	PO Box 27 00014, University of Helsinki Finland	mika.rekola@helsinki.fi
Riala, Maria	EFINORD/ SLU	Skogsmarksgränd 901 83, Umeå Sweden	maria.riala@efi.int
Roos, Anders	SLU	Box 7008 SE-75007, Uppsala Sweden	anders.roos@slu.se
Rudenstam, Susanne	Träbyggnadskansliet	Sweden	Susanne.Rudenstam@trabyggnadskansliet.se
Rørstad, Per Kristian	Norwegian University of Life Sciences	PO box 5003 1432, Ås Norway	per.kristian.rorstad@nmbu.no
Saastamoinen, Olli	University of Eastern Finland	PO Box 111 FI-80101, Joensuu Finland	olli.saastamoinen@uef.fi
Schubert, Florian	Worked in NEWFOREX for University of Hamburg (contract ended))	21033, Hamburg Germany	schubert808@gmail.com
Sjölje, Hanne K.	Norwegian University of Life Sciences	Pb. 5003 1432, Ås Norway	hanne.sjolie@nmbu.no
Solberg, Birger	Norwegian University of Lifes Sciences	P.Box 5003 1432, Ås Norway	birger.solberg@nmbu.no

Staal Wästerlund, Dianne	SLU	Skogsmarksgränd 90183, Umeå Sweden	dianne.wasterlund@slu.se
Stendahl, Matti	Swedish University of Agricultural Sciences	Box 7008 75005 , Uppsala Sweden	matti.stendahl@slu.se
Stenger, Anne	INRA-LEF	14 rue Girardet 54042, NANCY France	anne.stenger@nancy.inra.fr
Thorsen, Bo Jellesmark	University of Copenhagen	Rolighedsvej 23 DK-1958 Frb C, Copenhagen Denmark	bjt@ifro.ku.dk
Toppinen, Anne	University of Helsinki	Latokartanonkaari 7 00014, HY Finland	anne.toppinen@helsinki.fi
Tu, Gengyang	Laboratoire d'Economie Forestière, AgroParisTech	54000, Nancy France	gengyang.tu@nancy.inra.fr
Tyrväinen, Liisa	Metla	Jokiniemenkuja 1 P.O.BOX 18, Vantaa 01301 Finland	liisa.tyrvainen@metla.fi
Varela, Elsa	European Forest Institute	St. Antoni M. Claret 167 08025, Barcelona Spain	elsa.varela@efi.int
Vedel, Suzanne Elizabeth	University of Copenhagen	Rolighedsvej 23 1958, Frederiksberg C Denmark	sve@ifro.ku.dk
Wan, Minli	University of Helsinki	P.O. Box 27 (Latokartanonkaari 7) 00014, Helsinki Finland	minli.wan@helsinki.fi
Wunder, Sven	CIFOR	RUA DO RUSSEL 450 SALA 601 22210010, Rio de Janeiro Brazil	s.wunder@cgiar.org
Yonovska, Ilka	D.#.Cenov Academy of Economics	2 #manuil Chakarov 5250, Svishtov Bulgaria	iyonovska@mail.bg
Zhang, Yijing	University of Helsinki	00790, Helsinki Finland	yijing.zhang@helsinki.fi



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