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STATUSRAPPORT PROJEKT (ÅR 2007)

1. Projekttitel	Skogsbruk och virkesanvändning för minskad klimatpåverkan
2. Project title	Forestry and use of wood to mitigate climate change
3. Projektledare /kontaktperson (namn, adress, telefon, telefax, e-post)	Ljusk Ola Eriksson Swedish University of Agricultural Sciences Dpt. of Forest Resource Management SE-901 83 Umeaa SWEDEN Phone: +46 (0)90 786 83 07, Fax: +46 90 77 81 16 Mobile: +46 (0)70 644 000 4 E-mail: Ola.Eriksson@srh.slu.se Homepage: http://www.srh.slu.se/default.cfm
4. Huvudansvariga/ kontaktpersoner i övriga deltagarländer	Birger Solberg Norwegian University of Life Sciences (UMB) Dept. of Ecology and Natural Resource Management (INA) P.O.Box 5003, NO-1432 Ås, Norway Telephone: +47 64 96 57 28; Fax: +47 64 96 58 02 birger.solberg@umb.no http://www.umb.no/ina/ansatte/bso_e.htm Lauri Valsta Department of Forest Economics P.O.Box 27, FIN-00014 University of Helsinki, Finland Lauri.Valsta@helsinki.fi Phone +358 9 1915 7971 Fax +358 9 1915 7984 www.helsinki.fi/mmtdk/mmekn/

4. Projektperiod	Projektstart den 1/1 2007 Projektslut den 30/4 2008 Slutrapport den 31/8 2008
5. Projektförlopp (sätt kryss)	[x] Projektet fortlöper i stort sätt i enlighet med projektplanen [ ] Projektet fortlöper ej i enlighet med den ursprunliga planen (beskriv avvikelserna nedanför) ("I stort sett" innebär här att planen följts men att den blivit förskjuten i tiden, inte beroende på att aktiviteter inte fullföljts utan på att aspekter uppdagats som fordrar förnyade analyser för att kunna samlas i en meningsfull och trovärdig rapport.)
6. Genomförda aktiviteter under rapporteringsåret	Möten: • Mars 22-23, 2007, Uppsala: Genomgång av projektplan och avstämning och schemaläggning av aktiviteter. Synopsis etablerad för arbetsrapport 1 + 2 utarbetad (modeller och analyser). • November 29-30, 2007, Helsingfors: Avstämning av resultat från de olika delprojekten och utarbetande av plan för slutliga analyser. Synopsis etablerad för arbetsrapport 3 (generic resarch plan). (Övriga aktiviteter, se resultat nedan)
7. Uppnådda resultat under rapporteringsåret	1. Scenarier (3 st + ett basscenario) för ökad användning av konstruktionsvirke utarbetade, inkl. beräkning av den ökade konsumtion av färdiga produkter de implicerar. 2. Beräkning av utbudskurva för Sverige för bestämning av utbudselasticitet (övriga regioner givna från andra data). 3. GTM-modellen körd för respektive scanerium för att beräkna fördelningen av den ökade efterfrågan på sågade trävaror på länder och de jämviktpriser det medför (prognos 30 år). 4. Beräkning av virkesutbud vid av GTM-modellen givna priser för Sverige över motsvarande period. 5. En ny systemskiss etablerad utifrån de erfarenheter som erhållits i stegen 1-4 (stegen 2-4 kommer att göras om efter avstämningen i Helsingfors). 6. Beståndsanalyser gjorda som kan ingå i slutrapporten i slutgiltigt form.
8. Publicering/ förmedling av resultat **Projektets web-adress:**	(Ingen publicering gjord då analyserna måste göras om enligt ovan.)

9. Ekonomirapport 2007 (Euro)	Medelförbrukning 2007: SNS-medel 30,592 SNS-beviljning 2007 50,0000 Egna medel ? Övriga medel ? Specificerad förbrukning av SNS-medel: Summa ? Lön inkl. sociala kostnader 19,214 Resor 5,813 Andel SNS-finansiering ……% Materiel 1,281 Övriga kostnader 4,284 Summa 30,592 Ej förbrukade SNS-medel 2007 (22,525) (överförs till 2008) 19408?!
Datum 16 January 2008	Projektledarens underskrift

Forestry and use of wood to mitigate climate change

Summary

Climate change is the major long term environmental threat facing humanity. Forestry and related industrial sectors can play an important role in mitigating the effects caused by increased CO_2 levels. This can be done by sequestration of CO_2 in the forest biomass, increased use of forest based bioenergy and material substitution in the wood consuming sectors, particularly in the construction sector.

A number of studies in the Nordic countries show that substantial results in terms of climate change mitigation can be achieved by each of these means. However, analyses integrating forest management and substitution strategies are lacking. This is a serious drawback, when it comes to understand what strategies should be implemented, since there are strong interdependences between the mitigation measures. For instance, increased forest biomass sequestration reduces the quantities available for bioenergy substation of fossil fuels. Other interdependencies are transmitted by the price mechanism such that increased use of wooden construction material will tend to increase timber prices, resulting in more intensive forest management. The long time scales further complicates comparisons of strategies; whereas timber can substitute for fossil fuel today, the use of wood in construction will affect energy use in different sectors immediately and fossil fuel substitution when the house eventually is demolished a number of decades from now. A regional setting is necessary in order to assess impacts on supply and demand over time.

The purpose of this project is, firstly, to lay a solid foundation for this kind of analyses by (i) combining existing models of forest management on stand and forest level and models of wood substitution into an analytical framework, (ii) establish consistent linkages between the models, and (iii) identify missing models and linkages. Secondly, introductory regional level applications of the framework with scenarios of material and energy substitution will be conducted in order to demonstrate (i) the viability of the proposed approach, (ii) the possible improvements needed, and (iii) the greenhouse gas mitigation potentials of the forestry related system as a whole. Thirdly, a detailed project description is elaborated, as a basis for funding comprehensive and integrated analyses of strategies for the entire wood chain, including their implementation.

Background

Climate change mitigation is a major issue that can be addressed with different means within forestry and wood lifecycle as a whole. For example, the amount of carbon stored in the forest can be increased by modifying the forest management practices (carbon sink). Wood energy and wood products can replace fossil fuels and energy intensive materials as steel and concrete and carbon can be sequestered in wood products. Research on integration between forest management and substitution strategies are nearly lacking. The importance and need of such research have been pointed out (Gustavsson et al. 2005b).

Managing forest stands for increased carbon emissions reductions results in a different silvicultural guideline from normal economical use of forests as well as an increased demand for forest products. Zhou (1999) and Pohjola et al. (2005) suggest that increased carbon sequestration in forests is achieved by increasing growing densities and rotation length. These results neglect the use of wood to substitute for fossil energy intensive materials and fossil energy. Taking substitution into account will typically change the optimum timber assortment composition and the rate at which carbon is passed through the forest ecosystem. Stand level analyses using a simulation-optimization model such as the SMA software (Valsta and Linkosalo 1995) allow for optimum combination of the different goals in silviculture.

Incorporating carbon storage into forest planning at the regional scale clearly affects forest management by e.g. changing clear felling priorities (Hoen and Solberg 1994). When carbon storage in forest biomass is given a monetary value harvest levels will decline and this effect is more pronounced in areas with low production (Backéus et al. 2005). The study includes forest bio fuel at low local prices without price elasticity (e. g. due to changed cost for carbon mitigation) and not substitution of fossil energy intensive materials. Studies on forest or regional level are performed using an integrated analysis and planning system like the Heureka-system (Lämås and Eriksson 2003).

Increasing the use of wood material in construction is a potential option for reducing net CO_2 emission because of the relatively low fossil energy needed to manufacture wood products compared with alternative materials, the increased availability of bio fuels from wood by-products that can be used to replace fossil fuels, and the storage of carbon in wood building materials. Furthermore, using biomass for direct substitution of fossil fuels or fossil fuel-intensive materials provides permanent and cumulative reduction in CO_2 emission, whereas sequestration or conservation of carbon is typically limited so that the carbon sinks always saturate in the long run.

A growing body of knowledge also supports that wood-based material typically result in lower energy use and CO_2 emission compared to other materials such as concrete, brick or steel (Koch 1992; Buchanan and Honey 1994; Buchanan and Levine 1999; Börjesson and Gustavsson 2000; Lippke et al. 2004; Gustavsson and Sathre 2004, 2005; Petersen and Solberg 2005). Gustavsson et al. (2005a) developed a method to compare the net CO_2 emission from the construction of concrete- and wood-framed buildings. The method, applied to two buildings in Sweden and Finland, includes carbon accounting from emissions due to fossil fuel use in the production of building materials; the replacement of fossil fuels by biomass residues from logging, wood processing, construction and demolition; carbon stock changes in forests and buildings; and cement process reactions. They found the most important contributor to the lower CO_2 balance was the recovery of wood residues, including logging, processing, construction and demolition wastes, for use as biofuel to replace fossil fuels. Pingoud and Perälä (2000) estimated the maximum wood substitution potential in new building construction in Finland. The results indicated that nearly twice as much wood material could have been used in Finland in 1990 compared to the amount that was actually used. Most substitution studies, however, are lacking an active integration between wood demand from the industry and timber supply from the forest.

A preliminary case study integrating forest management, carbon sinks and substitution was performed in Pingoud et al (2006), which analyze the impacts of various forest management strategies on both carbon stocks, and substitution. The supplies of sawnwood, pulpwood and energy wood were given as input into the framework similar to Gustavsson et al 2005a, to estimate the impacts of replacing concrete houses with wooden houses on emissions and carbon stocks. The results showed that the quality of the wood produced (sawlogs, pulpwood, energy wood) had substantial impact on the substitution potentials. Some substitution factors were found to be less than one, implying that relative emission reduction is larger than the carbon content of the stemwood itself. Consequently, maximizing the biomass production does not necessarily lead to the maximal substitution benefits. According to the results, there could be win-win solutions in the long run: both higher substitution benefits and higher carbon storages might be obtained by the same forest management strategy in some cases.

Objectives

A comprehensive analysis of different forest management and wood substitution strategies for climate change mitigation requires the integration of forest management models on stand and regional level and as well as for wood substitution. Implementation issues, including consequences for future international agreements in the area, are central and should also be covered. The scope must range from natural resources to services required by end users.

Integrated analyses are the outcome of a major research undertaking that rests on a well established, integrated and multidisciplinary analytical framework. The main objective of the current project is to establish this framework and prepare for comprehensive studies. This entails the following activities:

1. Existing models of forest management on stand and forest level, forest product market models, and models of wood substitution are combined, the consistency of the linkages between models investigated and missing models and linkages identified.
2. Preliminary regional level application of the framework with scenarios of material and energy substitution is provided that demonstrate (i) the viability of the proposed approach, (ii) the possible improvements needed, and (iii) the greenhouse gas mitigation potentials of the forestry related system as a whole, including carbon sequestration into ecosystems and wood products and avoided emissions due to the wood-using chain.
3. A detailed project description is elaborated, to be forwarded to the appropriate funding authorities. The project should aim at comprehensive and integrated analyses of the viability to mitigate climate change by using different forest management and wood substitution strategies and to assess their implementation.

Research plan for the pilot project

1. Analytical framework

Models used for analysing carbon sequestration or wood substitution have covered only some aspects of using forest sector to mitigate climate change. The model framework that allows the integrated analysis of how to use forest sector as a whole to mitigate climate change is still to be developed.

In this pilot project, we will establish links between the existing models. Also, we identify the missing parts needed in the integrated model system that has to be built in a later phase. Existing models might need to be developed such that the concepts and measurement units are similar, so that models can use outputs from other models as inputs and vice versa. Also, micro level models have to be developed further in order to provide macro level scenarios. Including market level analysis with price responses is important as the prices of timber and end products are likely to change, that has a feed back impact on the amount substitution and sequestration.

Existing models to be integrated in this project include (a) forest stand model, (b) forest regional model, (c) forest product market model and (d) model for wood substitution, as described in Figure 1.

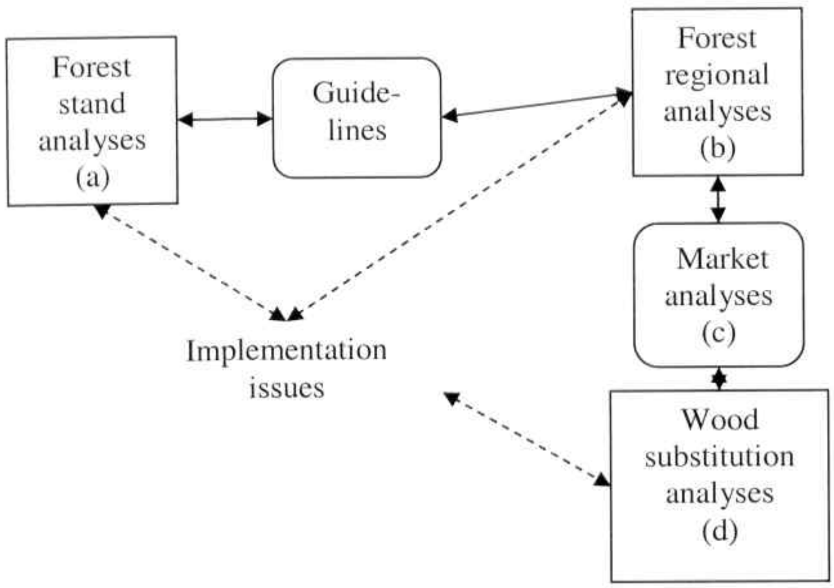

Fig 1. Existing models and examples of linkages between activities of the project.

a) In the stand level model the forest owner maximizes the discounted net income from timber production and possible carbon sequestration over time subject to economic and ecological parameters. The stand level model provides the optimal rotation age, and timing and intensities of thinnings with given targets or economic incentives for carbon sequestration.

b) In the forest regional model simulations for the forest growth are made for sample plots from e.g. National Forest Inventory. Guidelines for forest management are received from the stand level model. The simulations are performed numerous of times and then used as input to an optimizing model where demands for e.g. harvest level and carbon sequestration for the whole region are set.

c) Forest product market models link regional forest resources and wood and forest based bioenergy supply, the forest industry production and the market demand for forest products and wood-based bioenergy. Such models exists for Norway (NTM II, e.g., Bolkesjø and Solberg, 2006) and Finland (SF-GTM).

d) Micro-level model for wood substitution in house construction. Model inputs are the amounts of building materials needed to build a wood house and a reference house, built mainly in some other materials than wood. The outputs are: 1) the carbon emissions from producing the building materials, 2) the avoided fossil carbon emissions from using processing residues and demolished wood for bioenergy, 3) the amount of tree biomass needed to produce building materials; above numbers given for both the wood house and the reference house.

Examples of linkages between various models are represented in Figure 1. Interactions between forest production and wood substitution are essential. Timber demand/supply provides the major link between existing forest and substitution models. Timber supply is obtained from regional level model.

Stand and regional level models of forestry are linked through guidelines for forest management. Guidelines for final cutting age and thinning are obtained from stand level model, and they reflect different balances of carbon mitigation against economic gain. Regional model utilises guidelines to provide a regional scale to quantify the accumulated effect on carbon storage, timber supply and biofuel supply over time. Economic gains from carbon mitigation derived from stand level model and from substitution will be compared when making a regional forest management planning.

2. Scenarios on the impact of material substitution in construction on the total carbon balance of forests and wood-using chain

In the pilot project, we provide rough scenarios on the impact of material substitution in construction on the total carbon balance of forests and wood-using chain, based on existing scenarios on increased wood construction. Our scenarios are a means to illustrate greenhouse mitigation potentials of combined material and energy substitution. By such scenarios, trade-offs between carbon sequestration into forest biomass on one hand, forest based bioenergy production on the other hand, and avoidance of fossil carbon emissions due to increased wood use can be demonstrated. By identifying the most important interactions they assist in developing the integrated modelling framework in the next stage. Different scenarios are compared both from carbon balance and in economic terms.

Scenarios will be based on earlier analysis of project researchers on stand and forest level, and material substitution, and preliminary analysis using integrated framework. The micro level results on material substitution in construction sector will be utilised and turn to rough macro level scenarios.

Given the scenarios for increase in wood construction in Nordic countries, the substitution effects in the construction sector will be discussed as the demand of various timber species. Forest models are used to evaluate possible needs for modifying forest management in order to respond the new level of demand. The implied demands of timber species are implemented on a regional scale to quantify the accumulated effect on carbon storage, harvested timber and biofuels over time. The price responses are estimated with a market model.

The analysis expands the case study of Pingoud et al (2006) on impacts of various forest management strategies on both carbon stocks, and substitution by using an integrated framework by several respects: (i) the wood construction scenarios are the starting point of the analysis instead of forest management options; (ii) micro/stand level results are turned into macro/regional level accounting for the specific conditions in different Nordic countries; (iii) the links into bioenergy are improved; (iv) price responses are included; (v) scenarios are compared in economic terms in addition to impact on carbon balance.

Implementation issues are also discussed. Implementing the new policies in construction sector and forestry might involve economic instruments like carbon taxes or subsidies, legislation, recommendations or information.

Research Group

The research group combines the knowledge from various Nordic countries and disciplines (forest economics, economics, system analysis, engineering). The participating researchers are:
Swedish University of Agricultural Sciences: prof. Ljusk- Ola Eriksson, Ph.D. student Sofia Backeus
Mid-Sweden University: prof. Leif Gustavsson, Ph.D. student Roger Sathre
Finnish Forest Research Institute: Lic.Sc. Johanna Pohjola, Dr. Maarit Kallio, Dr. Riitta Hänninen
University of Helsinki: prof. Lauri Valsta
VTT Technical Research Centre of Finland: Dr. Kim Pingoud
Norwegian University of Life Sciences: prof. Birger Solberg
Norsk Treteknisk Institutt: M.Sc Jarle Svanaes

Communications

The results of the project are documented as follows:

1. A technical report describing the concepts, models and linkages of the analytical framework.
2. A report describing the results of the scenario analysis that provide a preliminary regional level application of the framework.
3. A document elaborating a major research plan aiming at comprehensive and integrated analyses of the viability to mitigate climate change.

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