Future forests scenarios:
Analyzing impacts of Swedish forest policy on ecosystem services, land use and the European market

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The Future Forests program

Future Forests is an interdisciplinary research program on the multiple uses of Swedish forests. The vision is to produce knowledge for a sustainable use of forests in a future influenced by climate change and economic globalization. Phase 1 of Future Forests has been carried out 2009-2012. IIASA's ESM program is planned to be a partner in phase 2, 2013-2016.

Phase 1 2009 - 2012

- Four qualitative, narrative scenarios of possible futures were developed by an interdisciplinary research team
- Stakeholders were involved to identify the external trends and drivers defining the scenarios.
- Scenario analysis was primarily intended to promote creative discussions between researchers in the program

Phase 2 2013 – 2016

- Continuation of future studies by quantitative scenario analysis focusing on two different approaches:
  - Normative scenarios and backcasting techniques will be used to describe and understand how interest groups view the future of Swedish forests, and
  - collaboration with IIASA to analyze consequences of Swedish forest use strategies on the European forest sector.

Collaboration between IIASA and Future Forests

The scenario analysis project will be run in close collaboration with IIASA. The IIASA ESM Integrated Model Cluster will be used to analyze consequences of Swedish forest use strategies on the European forest sector.

Issues to be analyzed include:

- the role of forests in climate change mitigation
- consequences of the Renewable Energy Sources directive on forest use
- how to handle trade-offs between conflicting interests imposed by the directive.

In phase 2, the ESM Integrated Model Cluster will be parameterized to enable estimates of effects on the European forest sector emerging from varying the Swedish export of forest products and bioenergy. Detailed biophysical and economic analysis as well as policy impact assessments will help increasing the practical value and applicability of the results and products deriving from Future Forests Program. In particular, phase 2 will benefit from the involvement of IIASA's integrated modeling cluster by its focus on forest-related (eco-systems) services, products, markets and trade streams, interactions with other sectors (i.e. agriculture) and consequential trade-offs between different possible future pathways.

Fig 1. visualizes the general concept of applying IIASA ESM Integrated Model Cluster in a combined approach with Swedish forest models during phase 2 of the Future Forest Program.

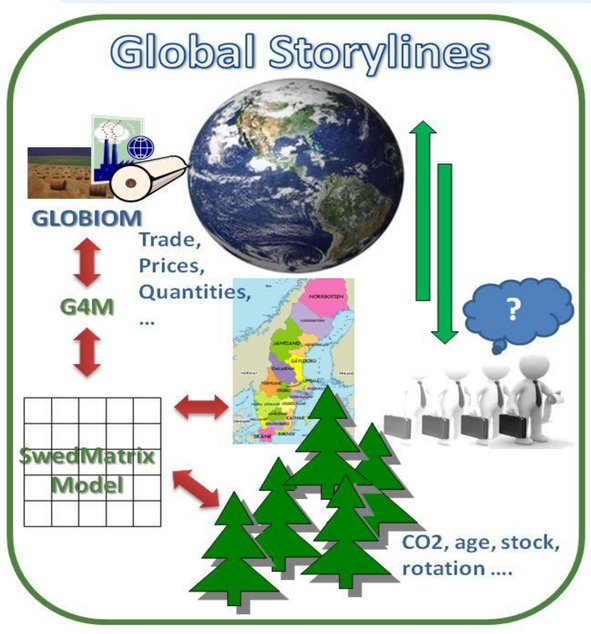

Fig 1. *Concept for a combined Future Forests-IIASA modeling approach.*

The following steps need to be addressed in order to generate a globally consistent Swedish scenario analysis at the national, sub-national and stand level:

- Model linkage establishment, consistent soft-linking of models, base year calibration and validation with Swedish data
- Scenario creation, translation of storylines into "hard data" as GLOBIOM input
- Running GLOBIOM (in fore- and backcasting modes)
- Output analysis (Assessment stage) interaction with global markets (trade) and global environmental issues (iLUC, GHG interaction), competitiveness assessment of the Swedish forest sector
- Potential creation of an economic model specialized on the forest sector and land use (e.g. GLOBIOM-Sweden).

Pilot study: Swedish forest management scenarios

The aim of this pilot study was to examine implications of different Swedish forest management scenarios with respect to carbon balance, including biomass carbon, harvested wood products and substitution, as well as the supply of other ecosystem services and impacts on trade using a systems perspective (Fig 2).

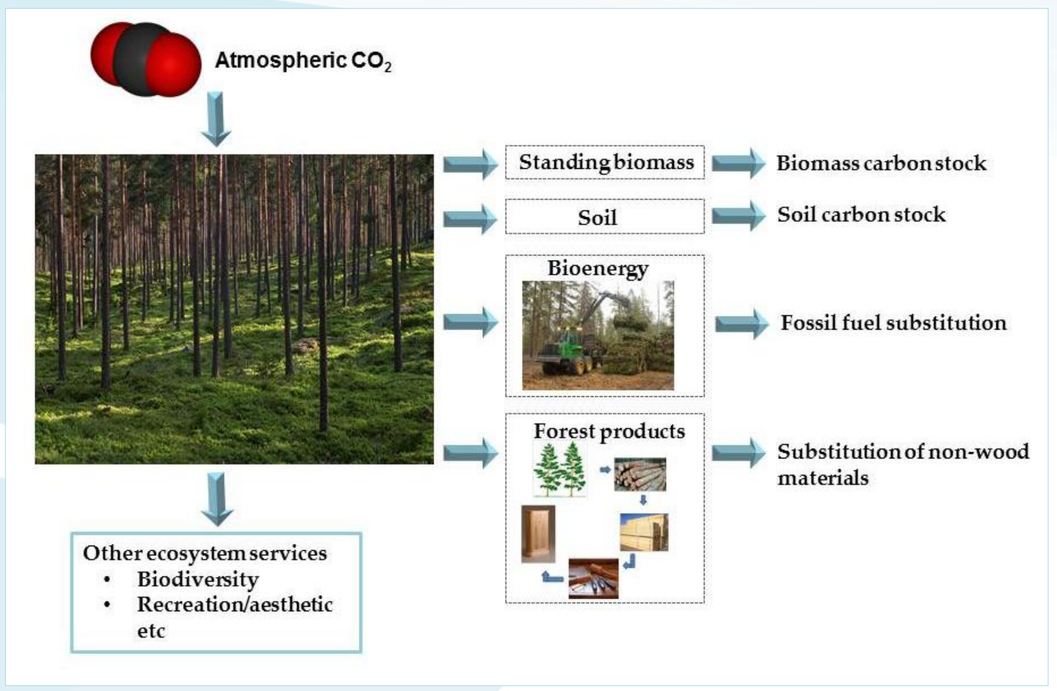

Fig 2. A schematic overview of the main components of the forest and forest products system considered in the study.

Three forest management scenarios with a 100 years horizon were produced for Sweden using the Hugin system, an empirical model estimating timber yield and potential harvest:

- **Reference** – Current management practice/business as usual, 6 % of productive forest area set aside without management
- **Environment** – 20 % forest area set aside without management
- **Biodiversity** – 50 % forest area set aside without management

Models for physiological processes, soil carbon stock changes, substitution effects as well as IIASA's economic equilibrium model GLOBIOM were used to explore the implications of these scenarios.

Implications for carbon balance and other ecosystem services

Preliminary results show that standing forest biomass carbon and soil carbon increases with increasing set aside areas whereas substitution and product carbon benefits increase with decreasing set aside areas. As a result of higher increase rate and lower harvest under the Biodiversity and Environment scenarios, the standing forest biomass is found to be greater compared to the Reference scenario. Total carbon balance results show that the Biodiversity scenario provides the greatest total carbon benefits, followed by the Environment scenario and then the Reference scenario (Fig 3).

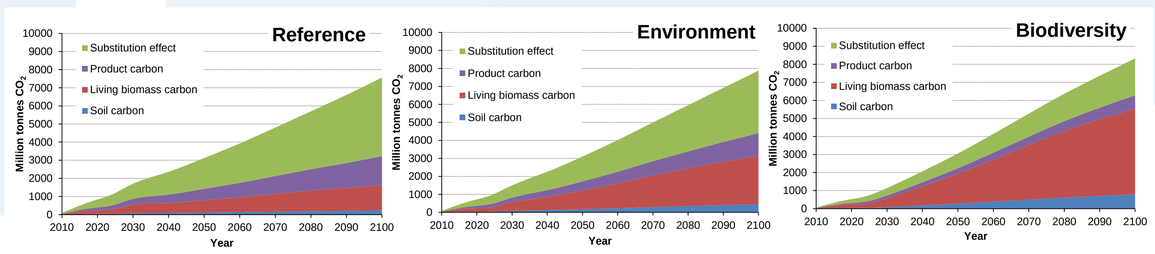

Fig 3. Total carbon balance for the three forest management scenarios including living tree biomass, soil carbon, carbon in forest products and substitution effects.

Old growth forest area and broadleaved forest area are larger in the set aside scenarios compared to the Reference scenario; thus, the set aside scenarios show a higher potential of increasing ecosystem services supply such as biodiversity and recreation in the future. However, with a still increasing demand for forest products, Sweden would import larger amounts of forest products and reduce its export significantly under the set aside scenarios.

Conclusions

The present study show that a Swedish forest policy where large areas are set aside will potentially affect carbon balance and other ecosystem services such as biodiversity and recreation as well as wood supply and trade on European level. Future studies will need to apply an integrated modeling approach to examine causes and effects in more detail under a range of different management scenarios.