NORWEGIAN FOREST PRODUCTS INDUSTRY – IMPACT ON CLIMATE AND VALUE ADDED

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ABSTRACT

Forests play an important role as carbon sinks. Productive forest area covers 24% of the total land area in Norway and the forests have a growing stock of 784 million m³. Annual increment is approximately 25 million m³, and annual commercial roundwood removal is approximately 8 million m³. In 2005 the net sequestration was calculated at 28.6 million tonnes of CO_2, which would offset 50% of the total greenhouse gas (GHG) emissions in Norway that year.

The forest products industry can play a significant role in combating climate change by optimising the use of raw material, increasing efficiency, producing bioenergy, substitution of materials with high content of fossil raw materials or energy, and by expanding into bio-refinery products while developing the competitiveness of the sector. Utilising this potential necessitates that the entire forest based value chain has to be analysed. Products have to be assessed both on the basis of their GHG balance and value added to arrive at correct decisions for climate friendly and profitable utilisation of the wood resources.

This paper presents results from an ongoing research project analysing material flows, GHG-balance and value added in the Norwegian forest products industry. The paper reports value added, GHG emissions and emission intensities for the Norwegian forest products industry at macro level. The project is the first phase of a larger research program covering the entire Norwegian forest based value chains.

Key words: Greenhouse gas emissions, value added, emission intensity, life cycle assessment, forest products.

INTRODUCTION

Greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004. Carbon dioxide (CO_2) is the most important anthropogenic GHG. Its annual emissions grew by about 80% between 1970 and 2004. Global atmospheric concentrations of CO_2, methane (CH_4) and nitrous oxide (N_2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years (IPCC 2007).

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Forests play an important role as carbon sinks. In Norway productive forest area covers 24% of the total land area, and the forests have a growing stock of 765 million m^3. Annual increment is approximately 25 million m^3, and annual commercial roundwood removal is approximately 8 million m^3 (SSB 2009). In 2008 the net sequestration was calculated at 28.6 million CO_2-equivalents, which would offset approximately 50 % of the total GHG emissions in Norway that year. The sequestration increased by about 153 per cent from 1990 to 2008.The average annual net sequestration from the Land-Use, Land-Use Change and Forestry (LULUCF) sector was about 19.9 million tonnes CO_2-equivalents for the period 1990-2008. The explanation for this growth is a continued increase in standing volume and gross increment in Norwegian forests, while the amount of CO_2 emissions due to harvesting and natural losses has been quite stable. The increase in living biomass is due to an active forest management policy, and to some extent to natural factors (Climate and Pollution Agency 2010).

The global forest products industry can play a significant role in combating climate change by optimizing the use of raw material, increasing efficiency, producing bio-energy, substitution of materials with high content of fossil raw materials or energy, and by expanding into bio-refinery products while developing the competitiveness of the sector (FAO 2006). Utilising this potential necessitates that products from the forest based value chain (forestry, wood working industry, pulp and paper industry) has to be analysed on the basis of their GHG balance and value added to arrive at correct decisions for climate friendly and profitable utilisation of the wood resources.

The objective of the work presented in this paper was to study value added, GHG emissions and emission intensities for the Norwegian forest products industry at macro level.

MATERIAL AND METHODS

This report is based on data from Statistics Norway. Data are mainly collected from Statistics Norway´s main subjects: 01 Natural resources and the environment, 09 National accounts and external trade, and 10 Industrial activities (http://www.ssb.no/english/subjects/).

The results are grouped on forestry and logging, wood and wood products, and pulp, paper and paper products.

Value added

Gross domestic product (GDP) is an indicator for total value added in a country, and also an expression for gross income generated from domestic production. GDP is measured in market prices, and is defined and compiled from three different main approaches: the production approach (I), the expenditure approach (II) and the income approach (III).

(I)
= Output (basic price) - Intermediate consumption (purchaser price) + Taxes on products - Subsidies on products

= Output (producer price) - Intermediate consumption (purchaser price) + Taxes on imports + VAT + Customs duties
= Total value added (basic price) + Taxes on products - Subsidies on products
= Total value added (producer price) + Taxes on imports + VAT + Customs duties

(II)
= Final consumption expenditure + Gross fixed capital formation + Changes in inventories + Exports - Imports
= Final uses - Imports
= Final domestic uses + Exports - Imports

(III)
= Compensation of employees + Operating surplus + Consumption of fixed capital + Taxes on production - Subsidies on production

Value added and gross income generated from domestic production in an industry or sector (or in total for all industries/sectors), is derived and defined as output less intermediate consumption. Value added is published in basic prices. Basic price is amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable to government, and plus any subsidy receivable from government, on that unit as a consequence of its production or sale.

GHG emissions

Figures for GHG emissions are based on the Norwegian emission inventory. The Norwegian emission inventory is a joint undertaking between the Climate and Pollution Agency and Statistics Norway. Statistics Norway is responsible for the collection and development of activity data, and emission figures are derived from models operated by Statistics Norway. The Climate and Pollution Agency is responsible for the emission factors, for providing data from specific industries and sources and for considering the quality, and assuring necessary updating, of emissions models like e.g. the road traffic model and calculation of methane emissions from landfills. Emission data are used for a range of national applications and for international reporting. The Climate and Pollution Agency is responsible for the Norwegian reporting to United Nations Framework Convention on Climate Change (UNFCCC) and to United Nations Economic Commission for Europe (UNECE).

Greenhouse gas (GHG) emissions are measured in CO_2-equivalents. In the environmental accounts, the following GHG emission components are included: Carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), PFCs (perfluorocarbons), HFCs (hydrofluorocarbons) and SF_6 (sulphur hexafluoride). The total emission of greenhouse gases is estimated by adding the emissions of all greenhouse gas components converted to CO_2 equivalents. The emission of greenhouse gases is weighted in relation to their heating potential with a global warming potential (GWP) value. The GWP value of a gas is defined as the accumulated influence on greenhouse effect from one tonne of emission of the gas compared to one tonne of emission of CO_2 over a given time period. The emission of greenhouse gases is weighted together to CO_2 equivalents by the GWP values. The GWP for the different gases used in the Norwegian emission model are: $CO_2 = 1$, $CH_4 = 21$, $N_2O = 310$, etc.

The Norwegian emission model uses approximately 130 industries (economic sectors).

Emission intensity

Emissions per unit of GDP are often used as a sustainable development indicator.

In this paper emission intensities were calculated as the ratio of the GHG emissions from an economic activity over the value added created by that same activity. To analyse the development over time value added was expressed in constant 2000 prices. The unit used for the GHG emission intensity here is tonnes of GHG emissions per million NOK (in 2000 prices).

RESULTS

In 2008 the turnover in the forest products industry (forestry, woodworking industry, pulp and paper industry) in Norway was 47.9 billion NOK (5.5 % of the total turnover in Norwegian industry).

4 100 persons were employed in forestry, 16 047 in the wood working industry, and 5 234 in the pulp and paper industry in 2008. In 1952 32 400 were employed in forestry, 31 700 in the wood working industry, and 21 500 in the pulp and paper industry

Value added

Value added for the forest products industry increased from 2.718 billion NOK in 1970 to 17.695 billion NOK in 2007. Estimated value added (real value) for the Norwegian forest products industry for the years 1970-2007 is shown in Fig 1.

Although the value added has increased significantly, the forest products industry´s share of the Norwegian gross domestic product (GDP) has been reduced during this period (Fig 2.).

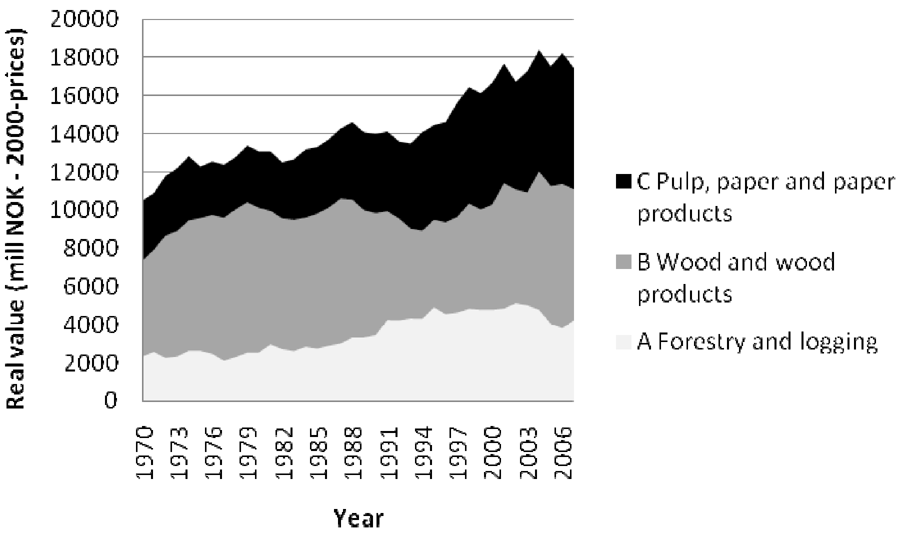

Fig. 1. Real value added (base year: 2000) in the Norwegian forest products industry (1970-2007).

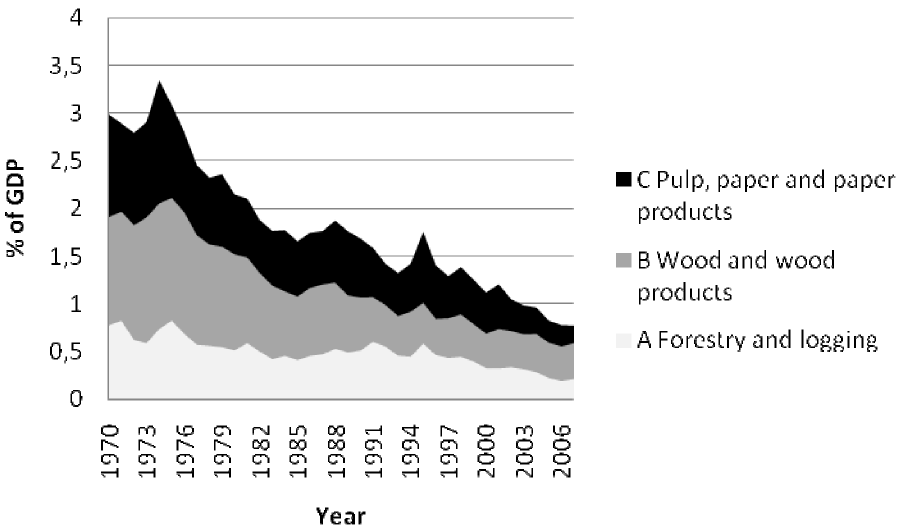

Fig. 2. Value added in the Norwegian forest products industry in percent of GDP (1970-2007).

GHG emissions

The total GHG emissions for Norway except international air transport and ocean transport were 49,7 mill tonnes CO_2-equivalents in 1990 and 53,7 mill tonnes CO_2-equivalents in 2008. GHG emissions from the Norwegian forest products industry for the years 1990-2008 are shown in Fig 3. Fig 4 shows the forest products industry´s share of the total Norwegian GHG emissions from 1990 to 2008.

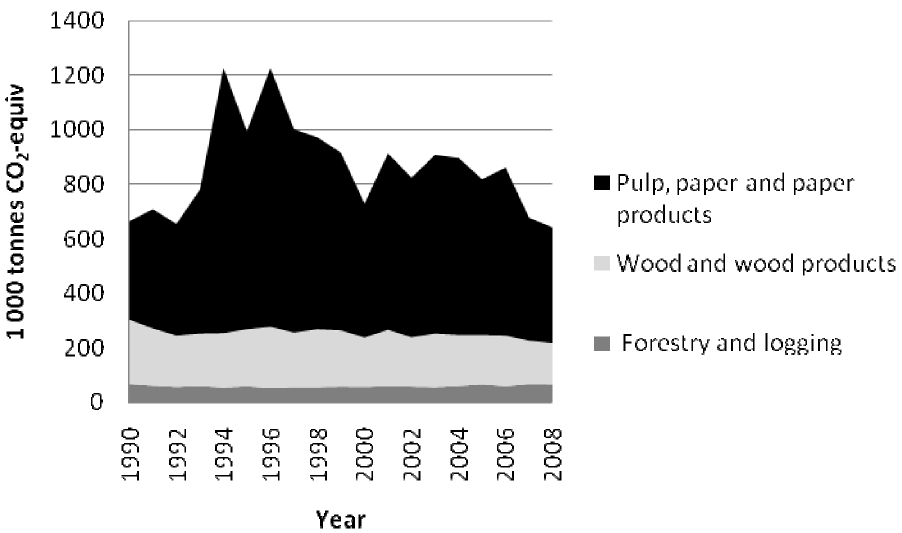

Fig 3. GHG emissions from the Norwegian forest products industry (1990-2008).

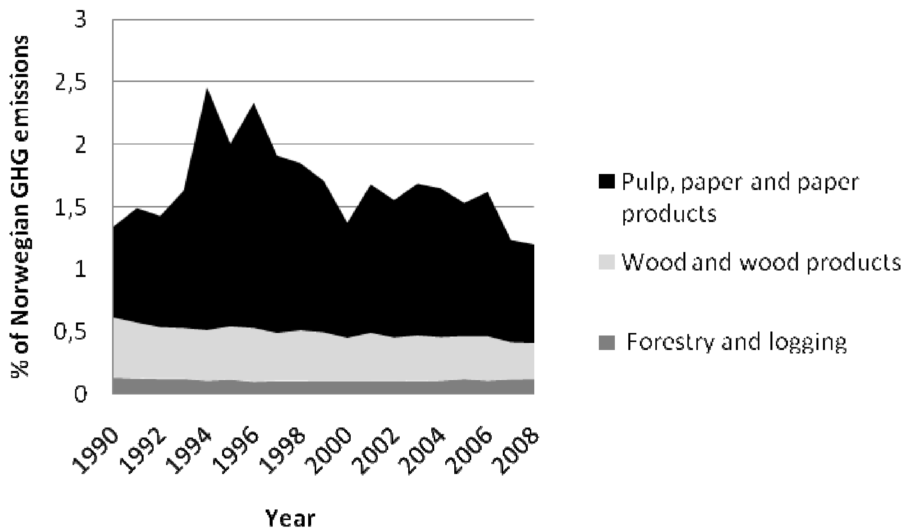

Fig 4. GHG emissions from the Norwegian forest products industry in percent of total Norwegian GHG emissions (1990-2008).

Emission intensity

Fig 5 shows GHG emission intensities for the Norwegian forest products industry for the years 1990-2008. Forestry had the lowest emission intensity and pulp and paper industry the largest. However, Fig 5 shows that the emission intensity in the pulp and paper industry has been considerably reduced in recent years.

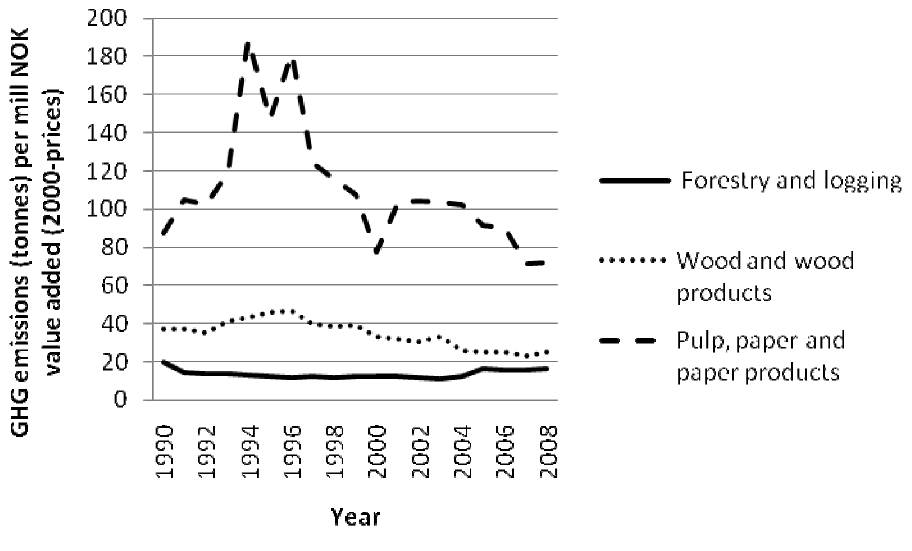

Fig. 5. Emission intensity in the Norwegian forest products industry calculated as tonnes CO_2-equivalents per mill NOK value added (1990-2008).

DISCUSSION

The calculated GHG emissions are partly based on energy statistics and activity data, and on reported figures from single plants, implying that several sources of error can occur. However, the results show very clearly that GHG emission intensity in the Norwegian forest products industry has been significantly reduced during the last 10 years. Another important characteristic is that the largest reductions have been achieved in the pulp and paper industry.

Regarding the forest products industry´s impact on climate it should be emphasised that this paper only focus on GHG emissions from industry. To give a more complete picture the carbon stock change in forest biomass and harvested wood products should be included, and the effect of using wood for energy and products instead of alternative products should be accounted. Combustion of fossil fuels is the main reason for the increased levels of CO_2 in the atmosphere and wood can substitute several energy and GHG intensive products. However, such an approach requires detailed and disaggregated studies to enable comparisons of different products. The top-down approach based on aggregated economic and environmental data lacks the level of details needed to distinguish the GHG balance and value added by specific processes within an industrial sector.

Life Cycle Assessment (LCA) is an objective method to evaluate the environmental burdens associated with a product, process or activity by identifying and quantifying energy and material uses and releases to the environment, and to evaluate and implement opportunities to influence environmental improvements. The method assesses the entire life cycle (cradle to grave) of the product, process or activities, encompassing extracting and processing material; manufacturing, transporting and distribution; use, reuse and maintenance; recycling and final disposal.

Life Cycle Inventories (LCI) is part of sustainable practices to aid choice of product, product improvements, and carbon sequestration policies. LCI data can be merged into scientific databases to enable a complete LCA of a system (product). LCI essentially measures all inputs and outputs for every stage through a cradle-to-grave assessment. LCA aggregates the data into key environmental risk indices like global warming potential. By comparing different products and manufacturing processes, LCA makes clear the trade-offs between one product and another. The 14000 series of the ISO Standards (ISO 2006) provides an internationally accepted framework for LCA.

Important issues, like system boundaries, definition of realistic life cycles, allocation of multiple inputs and outputs etc, have to be sorted out in the initial phase of the project.

In order to be able to calculate value added at product level, a more detailed method than used in traditional analyses on firm or sector level has to be adapted.

Sathre & Gustavsson (2009) developed a process-based methodology and performed bottom-up analysis based on the material and energy balances of specific industrial processes. By this approach it is possible to focus on the value added by particular industrial transformations, and to compare the value added by individual processes. Moreover, using this approach one can analyse innovative industrial processes for which technological process data are available, but are not yet established on a commercial scale and thus lack market data needed for macroeconomic analysis.

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