

## Forest biomass production and their potential use to mitigate climate change

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This paper examines how forest products can be utilized to contribute tackling climate change. An integrated model-based system analysis approach is applied to estimate forest biomass production and substitution effects of climate change and forest management goals. We estimate net primary production with the use of process based model BIOMASS incorporating climate change effects according to IPCC SRES B2 scenario. BIOMASS considers the processes of radiation absorption, photosynthesis, phenology, allocation of photosynthesis among plant organs, litter-fall, and the stand water balance. The resulting output of net primary production from BIOMASS is input into the empirical model HUGIN to calculate tree growth functions in five scenarios representing different forest management goals. These growth functions determine the total growth and the potential harvestable forest biomass. The harvested products in terms of whole tree biomass and stem wood biomass are then assumed to substitute construction materials and fossil fuels, and the substitution effect is calculated in terms of net CO<sub>2</sub> emission reduction. We use the Q-model to estimate soil carbon changes in the forest because of litter fall and soil decomposition processes in different scenarios. The results show that the climate change effect and intensive forestry practice can increase forest production and product harvest by up to 75% and 69% respectively compared to the production in the year 2010. If the harvested biomass is used to substitute fossil fuel and building construction materials a total net carbon emission reduction up to 249 Tg carbon is possible. The carbon stock in standing biomass, forest soils, and wood products all increases. The carbon stock changes are less significant than compared to the substitution benefits. This study can conclude that the climate change effect and improved forest management practices may increase forest biomass significantly, thus will give increased opportunity to reduce carbon emission significantly to contribute to the climate change mitigation.

**Keywords:** bioenergy, model, intensive forestry, substitution, carbon balance