How forest industries may contribute to environmental protection

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As a simple example, Burschel and Kürsten (1992) had calculated the CO_2-emissions resulting from the production of different pillars of 3 m length designed for the same load of 20 kN based on the energy consumption for their manufacture. Table 1 clearly demonstrates the advantages of wood, especially if compared to steel: The energy needed to produce a pillar that carries the same load is nine times higher for steel than for wood. Energy consumption usually is associated with emissions of CO_2 and other negative environmental impacts (such as coal mining, SO_2-emissions, cooling water consumption etc.). That means if you chose a material with a lower energy input (= embodied energy) at the same time you reduce environmental problems resulting from entire production process.

Table 1:

Comparison of Different Pillars of 3 m Length Designed for the Same Load of 20 kN

Materials:	Wood	Steel	Concrete	Brick
				
Weight:	60 kg	78 kg	300 kg	420 kg
	60 kWh	561 kWh	221 kWh	108 kWh
	15 kg	136 kg	54 kg	26 kg
	1	9.1	3.6	1.7

Primary energy input for production Resulting CO2 – emissions*
* Calculation based on the average German CO2 – emissions resulting from the primary energy consumption 1980 – 1985

Source: Burschel, P., Kursten, E. 1992. Wald und Forstwirtschaft im Kohlenstoffhaushalt der Erde. In: Produktionsfaktor. Umwelt: Klima – Luft. Hrsg. Verbindungsstelle Landwirtschaft-Industrie e.V., Energiewirtschaft und Technik Verlagsges.

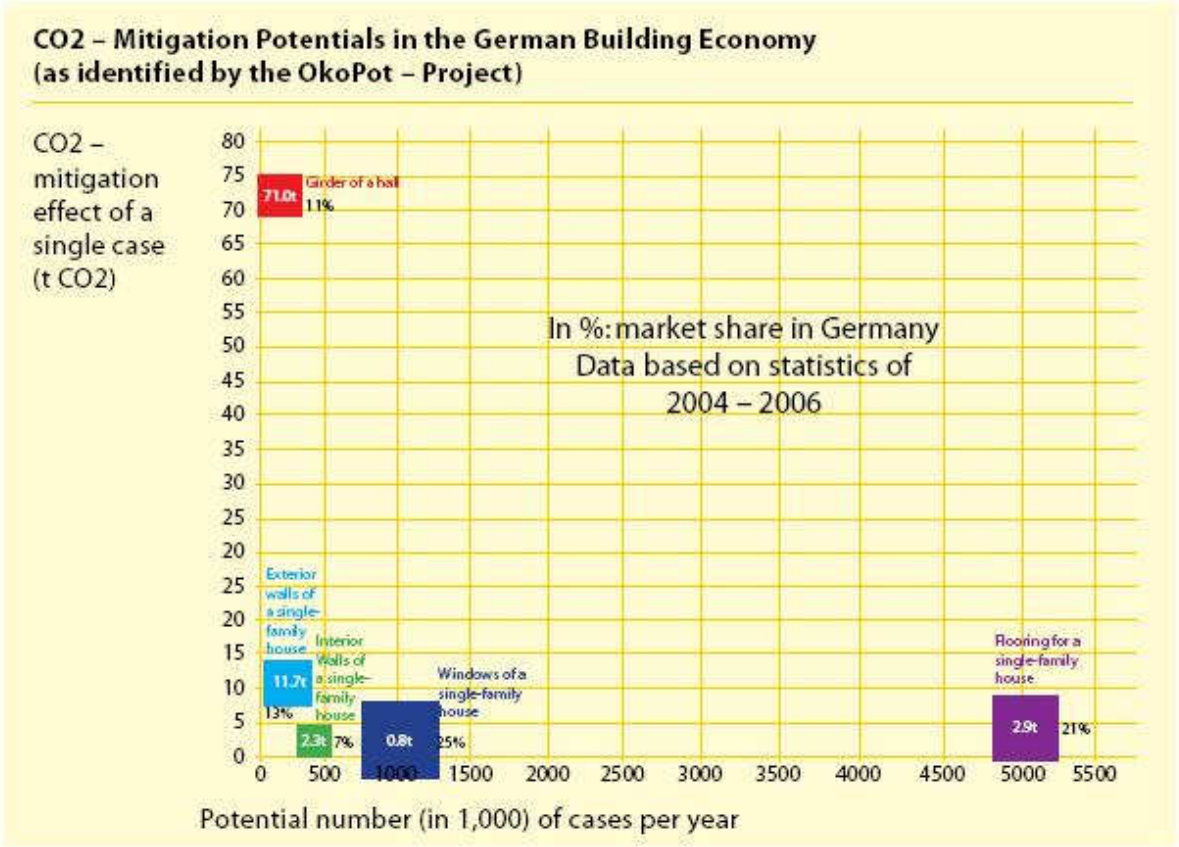
The World Summit on Sustainable Development (Johannesburg, 2002) plan of implementation states: *"We must develop production and consumption policies to improve the products and services provided, while reducing environmental and health impacts, using, where appropriate, science-based approaches, such as life cycle analysis (LCA)"*. Accordingly, since then in-depth analysis on the environmental impacts of many production processes have been carried out. (Life Cycle Initiative 2007)

In Germany, the entire production chain from forestry via sawmilling to final products like windows, flooring and complete wooden wall constructions has been analyzed in detail. Thereby, not only the energy consumption for the production process but the entire life cycle of the products, including maintenance of the products and their final disposal with all the

effects on the environment was taken into consideration according to the rules of a life-cycle assessment (LCA) (Frühwald et al. 1997, Wegener et al. 1997, Scharai-Rad, M., Welling, D. 2002, LCInitiative 2007). An LCA encompasses all inputs and outputs of a production process, the production of the input materials, the maintenance and final disposal of the product. For example, in case of a gluelam girder production, the inputs are sawn timber, electrical energy, heat energy, water, glue, preservatives, fat, paper / cardboard, plastics and metal. The outputs are the gluelam girders, shavings, packaging, CO_2, CO, CH_4, SO_2, NO_x, N_2O, solid waste, waste water, metal, paper + cardboard, glue residues, fat. All these input and outputs have to be exactly quantified and their environmental impacts have to be rated. The same has to be done with the comparable products made from other raw materials. Comparisons of wooden girders with such from steel or concrete, wooden windows frames with those made from PVC or aluminum and many other products, which man or may not be made from wood, have clearly demonstrated that making products from wood can signify-cantly reduce greenhouse gas emissions and other negative environmental impacts.

In a next step, a recent study in Germany estimated the potential of an increase in consumption of wooden products in the construction sector and the CO_2-mitigation effects resulting from the use of these opportunities (Braune, A. et al. 2007). Table 2 shows that using wooden girders for the construction of bigger commercial buildings etc. may have the biggest effect of 71 t of CO_2-reduction per case, but not that many buildings are being built annually. On the other hand wooden floorings are not that much better in terms of CO_2-emssions than the alternative material (PVC, carpet etc.), but here the market potential in much bigger.

Table 2:



Source: Braune, A et al. 2007, Verbundprojekt: OkoPot – Ökologische Potenziale durch Holznutzung gezielt fordern. 48pp (Comprensive summary of a research report, Oct. 10th, 2007, unpublished)

In February 2008, the results of another study have been published on how to develop sustainable markets for construction and refurbishment with wood in view of the recently upcoming shortages of wood in the German market (Kristof et al. 2008).

In the U.S., the Consortium for Research on Renewable Industrial Materials (CORRIM) has performed an intensive study to compare the environmental impact of entire house constructions based of wood respective to steel or concrete frame systems. Even though the latter contain a lot of wood products and the wooden ones also a lot of concrete and steel the overall "global warming potential" of the steel frame houses was 26% higher and of the concrete frame houses 31% higher as compared to the respective wood frame house. This study was based on "a consistent database of environmental performance measures associated with the production, use, maintenance, re-use, and disposal of alternative wood and non-wood materials used in construction of residential housing, i.e., from forest resource regeneration or mineral extraction to end use and disposal, thereby covering the full product life-cycle *from cradle to grave*." In all its research, CORRIM followed the 14000 series of standards of the International Organization for Standardization for the performance of LCA´s. (Lipke et al. 2004).

Of course, all these data depend on the energy consumption pattern in the respective country (Puettmann, Wilson, 2005). Even though they are quite different in India, the relationship between the different raw materials might be similar. Generally the efficiency of energy consumption (including electricity generation) is lower in India as compared to Germany or the US. On the other hand especially in the case of woodworking much more work is being done manually in India, thus reducing the energy input here. Studies on this topic have not been carried out in India up to now (Ravindranath 2007).

Basic precondition for the positive performance of wooden products is of course a sustainable forest management. Burschel et al. (1993), Marland et al. (1997) and Lipke et al. (2004) developed similar model calculations which include all the CO_2-mitigation effects of a forest that is being regularly harvested and reforested.

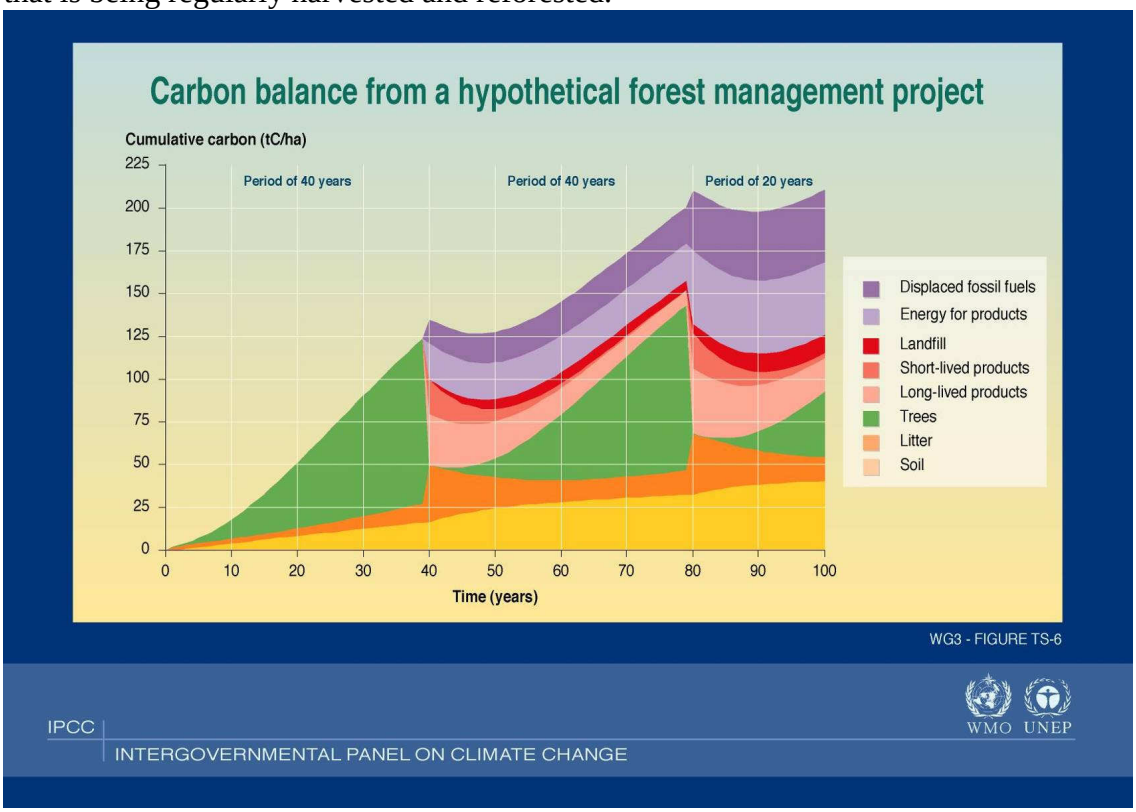


Table 3 (Source: http://www.ipcc.ch/present/graphics/2001wg3/large/03.03.jpg) is based on the GORCAM model (Marland et al. 1997) and shows: The loss of carbon stock on a hectare of forest land due to the final harvest of the forest plantation will be easily compensated for by the reduction of CO_2-emissions resulting from the use of timber products instead of other raw materials ("energy for products") and by the direct substitution of fossil fuels by wood fuel. Furthermore, it has to be taken in consideration that not all the carbon formerly stored in the forest immediately gets released to the atmosphere when a forest stand is being harvested. Large proportions stay in products and in the landfill for many years. In summary, this means that a sustainable managed forest will again and again contribute to climate change mitigation and environmental protection in general, while an unused protected forest only accumulates carbon up to a site-specific maximum level.

Of course, this is not only true for pure forest plantations: Kürsten and Burschel (1993) have shown, that agroforestry systems, even though they store less carbon in biomass, soil (and products) than forests (see also: Hooda et al. 2007), may have a lot of side effects that can effectively contribute to climate change mitigation: The most important one could be the protection of nearby forests from devastation due to their more sustainable production capacity as compared to pure agriculture. Minor effects may be the reduction of fertilizer and pesticide input possible in such mixed systems. This not only means a reduction of direct environmental impact but also of the energy required to produce those chemicals.

Finally, is has to be stated that timber is not the the material whose production may directly or indirectly reduce greenhouse gas emissions. Vengela et al. (2007) have successfully tested trusses made from bamboo for school houses or industrial buildings (14´- 18´ long) according to British standards (as Indian standards are lacking). They found them bearing the same loads while being 50% less expensive than steel trusses. Even if preservative treatment and metallic connections are taken into consideration, the overall environmental impact, in case of bamboo, might be even smaller than in case of wood and fefinitely if compared with steel or concrete girders. Bamboo also offers many other possibilities as a substitute for other raw materials: recently a corrugated roofing board was presented at the Indiawood 2008 fair, which could be a substitute for corrugated metal sheeting. Other DUROSAM®-products offer further applications in the furniture, construction and building sectors and they are even said to be "better than wood" (AB Composites 2008). - Producing non-wood forest products such as natural fibres, dyes, rosin and plant oils also offers possibilities to reduce the consumption of derivates of crude oil produced in chemical industries. Not only is the energy consumption for the processing of these natural products less, but also the amount of toxic by-products. To confirm this statement LCA´s will have to be carried out, of course.

Summarizing all these aspects, it has to be stated that in India, the restoration of many millions of forest land as well as the introduction of agroforestry systems would not only have the well known benefits such as soil conservation, watershed management and rural income. More wood and a broad variety of non wood forest products also would indirectly contribute to the relief of the environment from greenhouse gases, toxic chemicals, waste and waste water. Based on professional life cycle assessments for such products foresters and forest industries should jointly make public and politicians aware of their important role in environmental protection.

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