

activities was previously estimated with 2010 as reference year. Hence, the data used for allocation of wood products can be developed further with respect to different products and with respect to year the data are collected from. The study investigates five relevant scenarios: i) estimations based on data from single years, ii) estimations based on calculated averages, iii) estimates based on data from when measures actually took place, iv) sensitivity analysis on effects of fertilization, and v) estimates based on regional data. Climate gas emissions are within the interval 10,6 til 18,9 gwp/m<sup>3</sup>. Harvesting, transport to roadside and fertilization were the measures with the largest impact on emissions. In general, sawlogs from pine had the largest yearly variation in emissions. Furthermore, there is also substantial differences between emissions from aggregated products (i.e. estimated for both pine and spruce) and estimated emissions from specific tree species. The results indicate that results from the five scenarios differ by up to 30% for single products.

### Achieving India's forestry sector NDC: adapting to the changing climate is the key

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Under the Paris Agreement India has promised a Nationally Determined Contribution of 2.5 to 3 billion tons of additional CO<sub>2</sub> sequestration by 2030. This translates roughly into Forest Landscape Restoration over 26 Mha but in the three years since the Agreement almost no progress could be made. This is because the policy approach has been largely to reach the target by bringing 33% of country's geographic area under forest and tree cover from the current level of 24.39% but very little lands are actually available for allowing it to happen. This paper proposes that the NDC targets can only be achieved by enhancing the Net Primary Productivity of all types of forests in India from their currently abysmally low levels by enhancing soil moisture retention, replacement of weeds by ecologically appropriate species, reducing their vulnerability to pests and diseases through the use of innovative silvicultural tools, and drastically reducing the incidences of wildfires. Since these adverse conditions have worsened in the recent decades largely due to the changing climate a very large scale and comprehensive transformational approach to adaptation that would involve the active, and income enhancing, participation of a large number of local population is proposed. The expected high levels of investments in adaptation to the changing climate under the Paris Agreement would make it financially feasible.

## B8q: CLIMATE CHANGE AND THE FOREST ENVIRONMENT

### Substitution effects of wood-based products in climate change mitigation

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Forests store carbon in biomass and soil and when harvested, part of the carbon is stored in wood products. These products may substitute functionally similar products made from more emission-intensive materials. We reviewed the existing literature to update and improve the understanding of the climate effects of substituting wood products. We conducted a systematic review covering over 50 studies and yielding over 400 substitution factors. Most studies focused on North America and the Nordic countries in Europe with only few studies from other regions. Most of the substitution factors related to construction materials, and substantially fewer substitution factors were available for other product types (furniture, packaging, and textiles) and even fewer for paper and chemicals. Overall, the reviewed studies suggest an average substitution effect of 1.2 kg C / kg C, which means that per kilogram of wood products that substitute non-wood products, there occurs an average emission reduction of 2.2 kg CO<sub>2</sub>. However, the substitution effects vary significantly, depending on the wood and non-wood products considered and the assumptions applied to estimate emissions. We conclude that the use of wood products is generally associated with lower fossil and process-based emissions, compared to non-wood products. However, substitution factors as such are not sufficient to guide policy-making. The fundamental aim should be to minimize emissions, through forest management activities, long-term storage of C in wood products and substituting emission-intensive materials. Resource-efficiency and minimizing material waste for both wood and non-wood based products should be simultaneous policy targets for climate change mitigation.

### Environmental heterogeneity of *Araucaria angustifolia* populations in Central-South region of Brazil: a preliminary analysis

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*Araucaria angustifolia* (Bert.) O. Kuntze (Araucariaceae) is a subtropical rain forest tree that has social and economic importance due its wood quality and eatable seeds. To increase the knowledge about its genetic variability and its probable relationship with the physical environment, we are performing the edaphic, landscape and climatic characterization of natural populations occurring in a wide region including the latitudinal limits of Brazilian territory. From October 2015 to August 2016, we selected *A. angustifolia* trees from natural populations representing four Brazilian States. In those places, individuals were sampled, georeferenced (latitude, longitude, altitude), the relief was characterized and the soil were classified according to Brazilian Soil Classification System. Descriptive and cluster analysis, with field information, allowed the preliminary evaluation of these environments. As for edaphic aspect, the main classes of soil observed are Latosols (Oxisols), Cambisols (Inceptisols), Neosols (Entisols) and Nitosols (Alfisol). The southernmost sampled populations of Brazil (Pelotas region, Rio Grande do Sul State) are distinct from others by their lower altitude, around two hundred and ninety meters, and prevalence of shallow soil. Environments with the greatest contrast to this condition were located in the south of Minas Gerais State, with populations established over two thousand meters of altitude. Populations surviving in stressful environments are very important for conservation purpose, as result of local adaptation driving by extreme conditions. The attributes analyzed compose an information plan that will help to project the present and future occupation of these populations based on the IPCC scenarios.