

Life cycle assessment for wood harvesting in Turkish forestry conditions

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Abstract: The aim of the study was to expose the energy expenditure of human and machine power and to calculate the CO₂ emission of harvesting operations. In this concept, timber harvesting operations was analyzed according to time and motion analysis method, thus, the average time consumption was determined in clear felling and tending operations within Ağlasun Forest Planning Unit located in Isparta Regional Directorate of Forest District. Human and machine power energy consumed in logging process was fixed through measurement method with metabolic holter and/or calculation method with standardized model. The exhaust gases (CO₂) emission amount resulted from the chainsaws used in cutting operations, the agricultural tractors used in skidding and loading operations, and trucks used in hauling, were estimated by means of relationship between fuel consumption and emissions. The calculation of the energy expenditure was also based on the fuel consumption of the machines and working time. As result, in the harvesting operations, it was determined that the average time consumption was amount 74,56 minutes in cutting process with chainsaw and axe; 17,77 minutes in ground skidding with rolling; 5,17 minutes in loading with grapple loader and 3,78 minutes in truck hauling for one cubic meter of brutian pine wood procurement. Thus, the total time consumption was calculated as 1,69 hour/m³ for logging operations and 1,87 hour/tour for two way hauling. The energy expenditure amount was 23237,48 kcal/m³ through whole harvesting process. The exhaust gas emission was estimated as 6,82 kg CO₂/m³ and the noise level 81,33 dB(A) in working environment. The total energy content/equivalent of the unit product was calculated as 2878350 kcal/m³ and embodied CO₂ content was 988,2 kg/m³ for the products. The energy balance ratio, input to output, was calculated as 0,8 % per unit cubic meter.

Keywords: Wood harvesting, Energy consumption, Time and motion analysis, Exhaust emission, Noise effect, Technology level