Geophysical Research Abstracts
Vol. 19, EGU2017-6494, 2017
EGU General Assembly 2017

Carbon footprint of forest and tree utilization technologies in life cycle approach

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In our research project a suitable method has been developed related the technological aspect of the environmental assessment of land use changes caused by climate change.
We have prepared an eco-balance (environmental inventory) to the environmental effects classification in life-cycle approach in connection with the typical agricultural / forest and tree utilization technologies. The use of balances and environmental classification makes possible to compare land-use technologies and their environmental effects per common functional unit.
In order to test our environmental analysis model, we carried out surveys in sample of forest stands. We set up an eco-balance of the working systems of intermediate cutting and final harvest in the stands of beech, oak, spruce, acacia, poplar and short rotation energy plantations (willow, poplar).
We set up the life-cycle plan of the surveyed working systems by using the GaBi 6.0 Professional software and carried out midpoint and endpoint impact assessment.
Out of the results, we applied the values of CML 2001 - Global Warming Potential (GWP 100 years) [kg CO_2-Equiv.] and Eco-Indicator 99 - Human health, Climate Change [DALY]. On the basis of the values we set up a ranking of technology. By this, we received the environmental impact classification of the technologies based on carbon footprint.
The working systems had the greatest impact on global warming (GWP 100 years) throughout their whole life cycle. This is explained by the amount of carbon dioxide releasing to the atmosphere resulting from the fuel of the technologies.
Abiotic depletion (ADP foss) and marine aquatic ecotoxicity (MAETP) emerged also as significant impact categories. These impact categories can be explained by the share of input of fuel and lube.
On the basis of the most significant environmental impact category (carbon footprint), we perform the relative life cycle contribution and ranking of each technologies.
The technological life cycle stages examined in the stands are the followings:
Stage 1. cleaning cutting
Stage 2. selection thinning
Stage 3. increment thinning
Stage 4. final harvest
In these priority impact categories, the life cycle contribution of technologies varied according to the life cycle stages.
• The spruce stand showed the smallest contribution in the stages 1, 2, 3 alike.
• After the large contribution of beech stand at the beginning (stage 1), it continues representing a moderate level in stage 2 and 3, and it shares the smallest rate in final harvest (stage 4).
• The oak stand showed the largest contribution in the stages 2, 3, 4 alike.
• In the case of acacia and poplar, we have got the same results as in the case of oak stands.
• In the case of short rotation energy plantations (willow, poplar), we got the results typical on stage 4 of spruce stands.
We can conclude, that in case of the stage of final harvest, which represents the most significant environmental impact, the ranking of working systems showes the increasing order of „energy plantations – beech – spruce – acacia – poplar – oak".
The environmental assessment of technological aspects of land use and land use change represent an important added value to the climate research.
Acknowledgement: This research has been supported by the Agroclimate.2 VKSZ_12-1- 2013-0034 project.

Keywords: life-cycle assessment / forest utilization technology / carbon footprint / life-cycle thinking