Dendromass4Europe.eu

Factsheet – The Sustainability of Dendromass Production

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Introduction

Dendromass4Europe demonstrates the establishment of short-rotation wood Cropping in Western Slovakia and its complete Dendromass-material use for bio-based materials. Innovations are seen as drivers of economic and social progress as well as environmental degradation. Anticipating the potential impacts of innovations—already during their development—is essential for sustainable development. The objective of this task is to anticipate critical environmental and socio-economic hotspots and derive measures for improvement together with the project partners. In this poster, the focus lies on the results of the dendromass production only. The results of the total D4EU impacts as well as of each product system are presented in separate posters.

Production System

Dendromass production describes the activities on the fields of short rotation coppice in Slovakia comprising field preparation, planting of poplar rods, harvesting in a five years cycle as well as storage and transportation of the logs. There are various sites for cultivation spread over several regions in Western Slovakia (Figure 1). So, it can be defined either as local process, taking into account every single field separately or as national process regarding Slovakia as country of origin in total. IKEA Industry is primarily responsible for all stages of dendromass production.

People

A precondition for the success of a project is to have the acceptance of the community and the willingness of farmers to adopt it. In general dendromass production is accepted in the community when the perceived benefit is the strongest predictor for social acceptance (Fig. 4). Also, farmers are willing to adopt dendromass production, though some barriers (Slovakia's land fragmentation in combination with the required landowner's consent) but also incentives (economic benefit from using low-quality lands) are at place (c.f. Ranacher et al., 2021). Fig. 5 illustrates the potential social risks with dendromass production in Slovakia where most indicators form a medium risk and just a few have a high risk potential. Fatal occupational accidents were identified as a rather high social risk, though this is on the basis of generic forestry data. A higher risk is also expected with regards to unemployment among people form Roma communities and people with only basic education (c.f. Fürtner et al., 2020; D5.6).

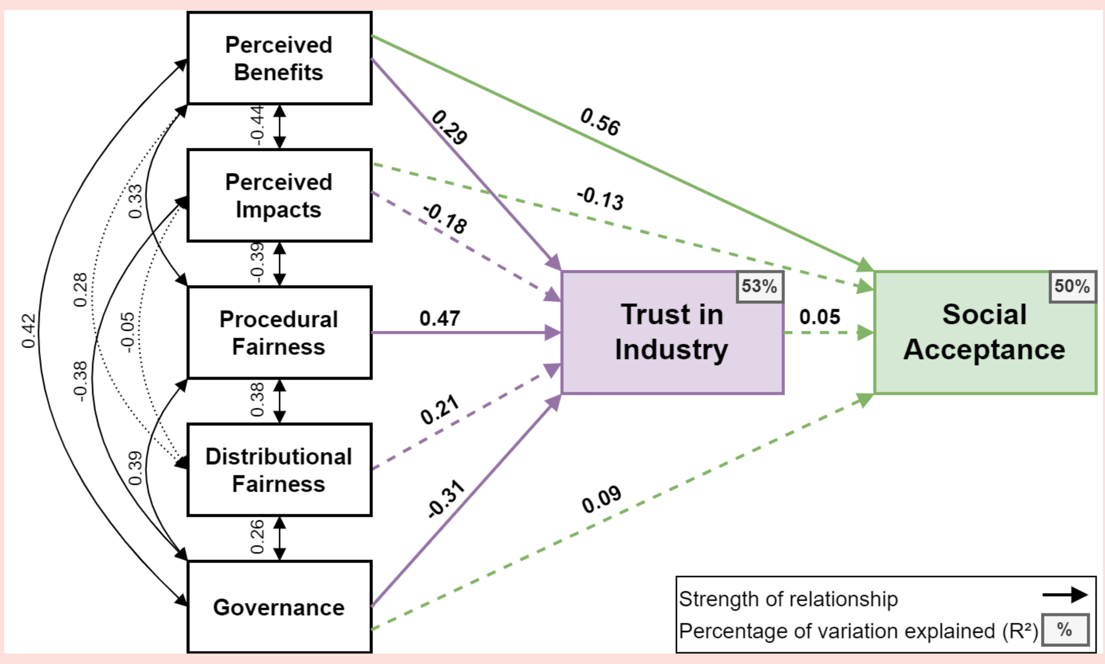

Figure 4: Social acceptance of short rotation plantations. For more information see Pichler et al. (2022)

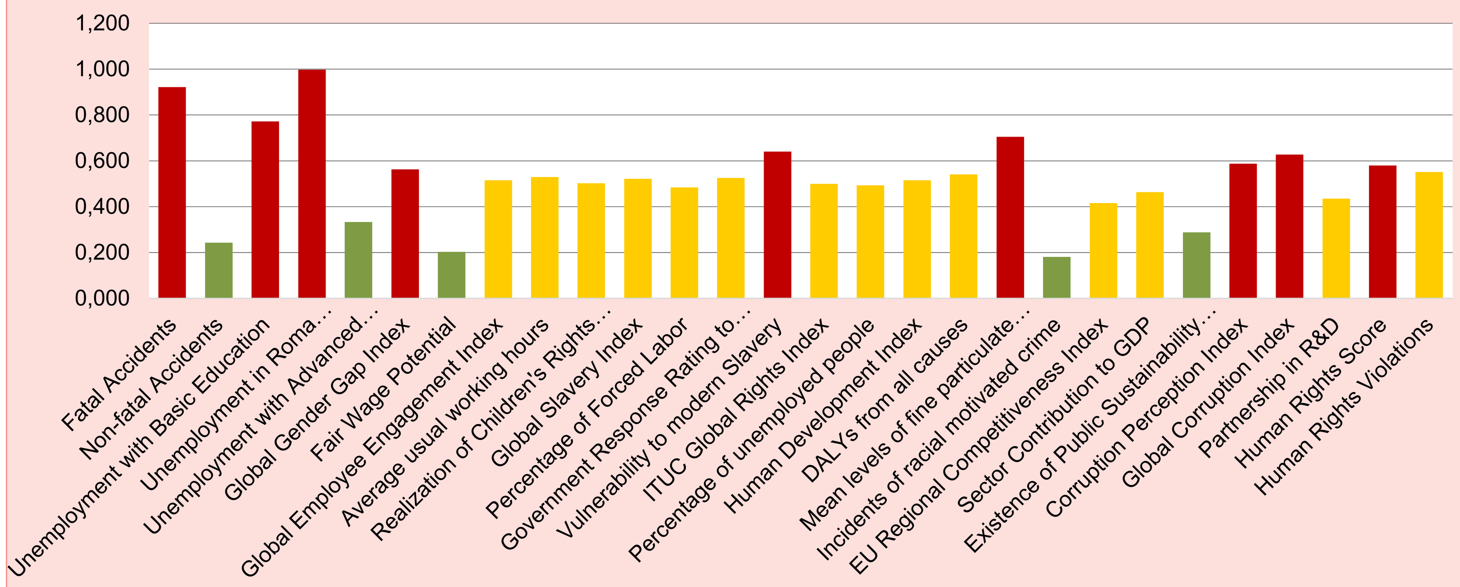

Figure 5: Social risks of dendromass production (green=lower risks; yellow=medium risk; red= higher risk)

Actions for Improvement

Based on the insights gained through the assessment, several recommendations for actions to improve sustainability performance can be provided:

- provide science-based facts to farmers and other stakeholders to inform about the impacts and manifold benefits to increase the acceptance towards SRP;
- select technologies with less risks for occupational health and safety;
- offer trainings and employment, especially for disadvantaged groups of people;
- increase the share of regional inputs to contribute to regional value creation;
- reduce environmental impacts, increase productivity (yield/ha), or efficiency (inputs/ha) or a combination of both to increase eco-efficiency;
- mechanical weed control bears potential to reduce fuel use and decrease of soil disruption and soil organic carbon release;
- ensure SOC stock also after plantation is transformed back to annual cropping;
- carefully consider practice of stump excavation at the end of the plantation lifetime to reduce environmental impacts and to avoid GHG emissions from land use change, i.e. expected impacts on soil organic carbon increase achieved during plantation lifetime.

Further Reading

Deliverable 5.5; 5.6 & 5.7 of tasks 4 in Dendromass4Europe

Fürtner, D., Perdomo Echenique, E. A., Hörtenhuber, S. J., Schwarzbauer, P., & Hesser, F. (2022). Beyond Monetary Cost-Benefit Analyses: Combining Economic, Environmental and Social Analyses of Short Rotation Coppice Poplar Production in Slovakia. Forests, 13(2), 349.

Fürtner, D., Mair-Bauernfeind, C., Hesser, F. (202X). Proposing a multi-level assessment framework for social risks of bio-based value chains and its contribution to the Sustainable Development Goals. Progress in Life Cycle Assessment

Pichler, C., Fürtner, D., Hesser, F., Schwarzbauer, P., & Ranacher, L. M. (2022). The Role of the Social Licence to Operate in the Emerging Bioeconomy—A Case Study of Short-Rotation Coppice Poplar in Slovakia. Land, 11(9), 1555.

Ranacher, L., Pollakova, B., Schwarzbauer, P., Liebal, S., Weber, N., & Hesser, F. (2021). Farmers' Willingness to Adopt Short Rotation Plantations on Marginal Lands: Qualitative Study About Incentives and Barriers in Slovakia. BioEnergy Research, 14(2), 357-373.

Planet

Depending on different soil types, an increase in soil organic carbon content during the lifetime of the plantation can be expected (Fig. 1). Tab. 1 summarizes the potential environmental impacts global warming potential (GWP), terrestrial acidification potential (TAP), ozone depletion potential (ODP), freshwater eutrophication potential (FEP), fossil depletion potential (FDP) and cumulative energy demand (CED) Fig. 2 indicates that stump excavation, mechanical weed control and felling-bunching have a high contribution to the total GWP of the SRP cultivation processes. Therefore, different scenarios (Fig. 3) were calculated to check if the impacts can be reduced by 1) cut-to length harvesting, using a disk-saw instead of shears for the feller-buncher; 2) Harvester and forwarder as harvesting machinery; 3) inclusion of grass cutting and herbicide application compared to the Base Case were harvesting is conducted with a feller-buncher (with shears for cutting) and trees are extracted by tractor. Only minor reductions can be achieved by the different harvesting technologies. For more information see D5.8 of the D4EU deliverable.

Table 1: Potential environmental impacts of dendromass production

Impact category	Value/1 ton bone dry dendromass
GWP (kg CO_2-Eq)	41.67
TAP (kg SO_2-Eq)	0.05
ODP (kg CFC_{11}-Eq)	$8.24 \cdot 10^{-6}$
FEP (kg P-Ep)	0.0004
FDP (kg oil-Eq)	15.82
CED (MJ)	479.13

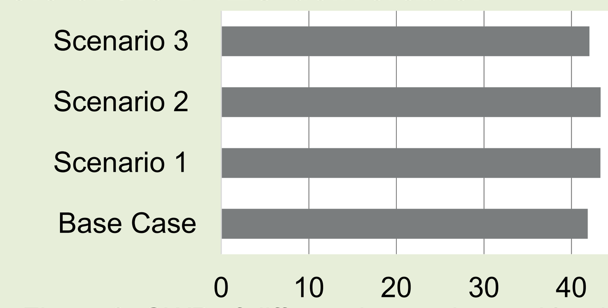

Figure 3: GWP of different harvesting and land managment practices (kg CO_2 eq.)

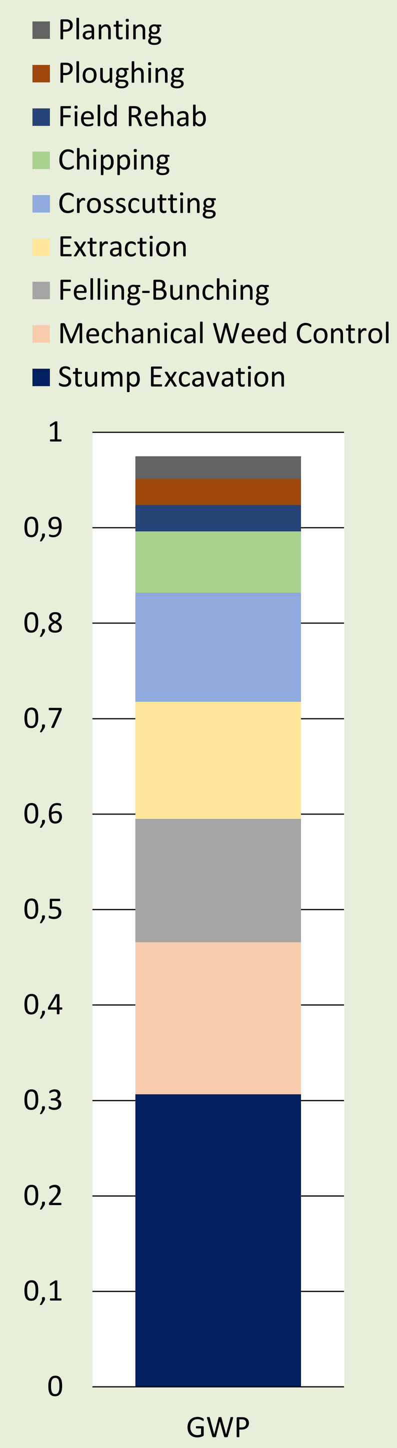

Figure 2: Contribution analysis for the GWP (kg CO_2-Eq) of the dendromass production.

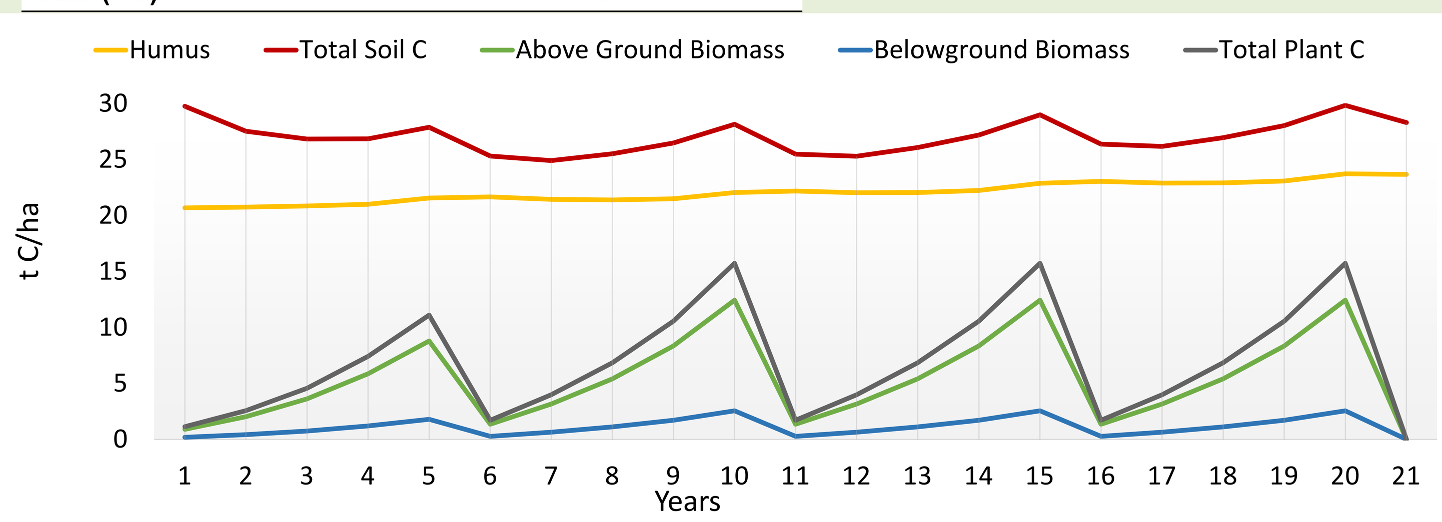

Figure 1: Total Carbon Fluxes of Plants and Soil accumulation over the period of 21 years incl. land use change .

Prosperity

The cost-benefit analyses showed that for farmers, dendromass production is not very lucrative (Fig. 6), though this highly depends on the actual crop prices of the reference crops. However, dendromass production is not just about making money, which is recognized by interviewed plantation managers who mentioned besides possible burdens, several financial and non-financial benefits, like reliable payment, the utilization of marginal lands, or favorable climatic effects (Fig. 7). Fig. 8 illustrates the value added (VA) relative to the net present value (NPV) and Tab.2 provides a summary of the eco-efficiency of different impact categories. The dendromass production results in the lowest eco-efficiency and with the molded fiber parts (NBBM 2) the highest value can be achieved. More detailed information can be found in Fürtner et al., 2022 as well as in the deliverables 5.6 and 5.7.

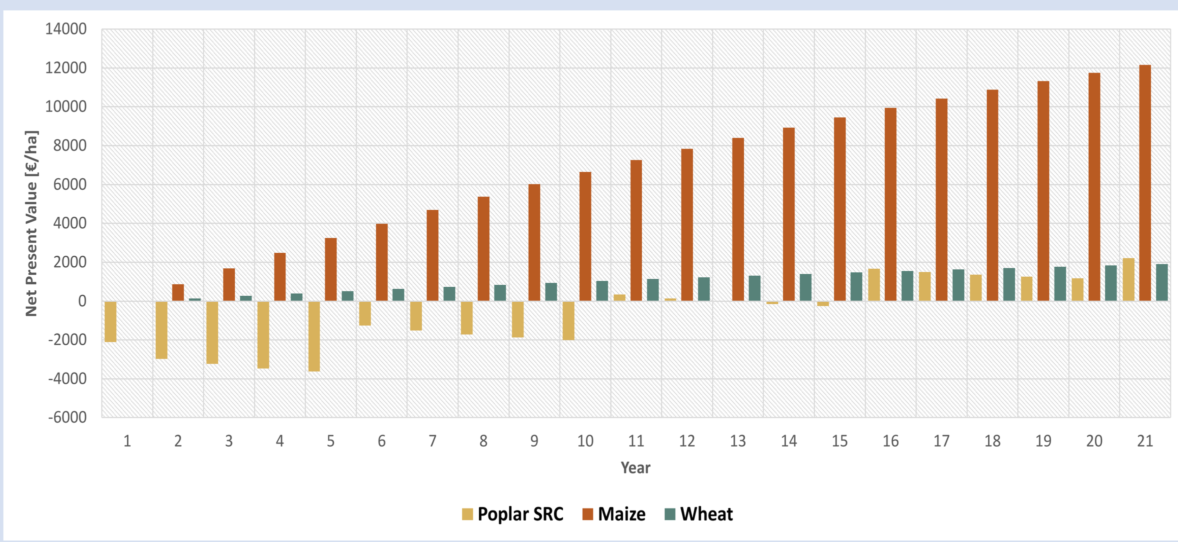

Figure 6: Net present value per area unit (ha) of different crops.

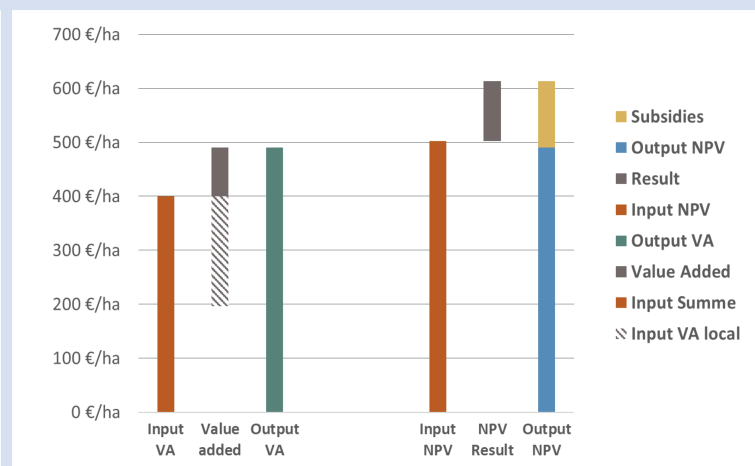

Figure 8: Value added per ha over a 20-year period relative to the NPV/ha per year for poplar short rotation plantations

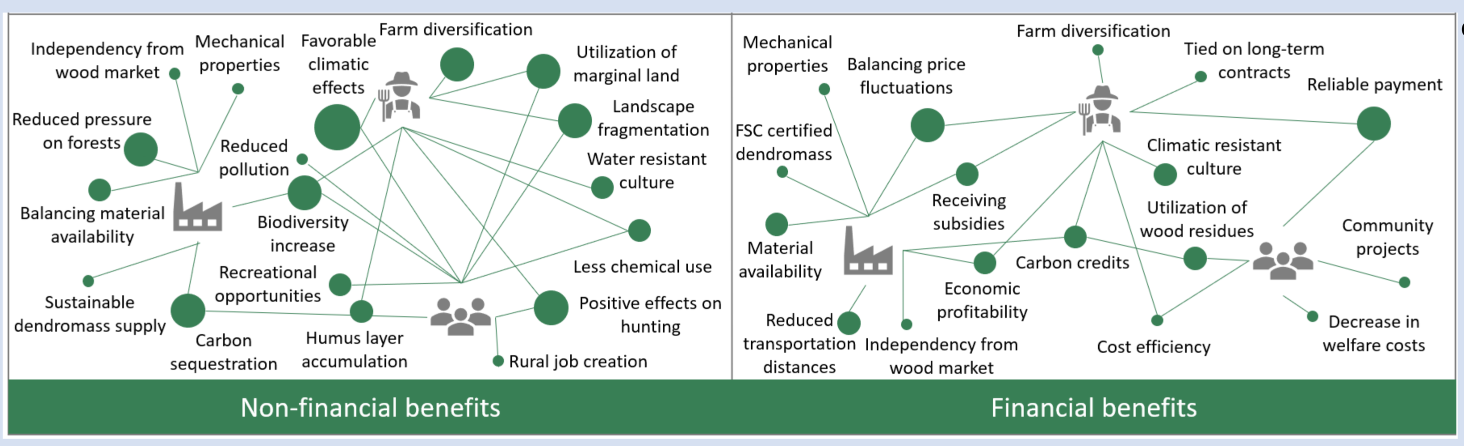

Figure 7: Perceived non-financial and financial benefits of poplar short rotation plantations (the bigger the dots, the more often the effects were mentioned by the interviewees).

Table 2: Eco-efficiency (value added/ env. impact) of dendromass production

Eco-Efficiency (Base Case)	Value/1 ton bone dry dendromass
VA (€)/ **GWP** (kg CO2-Eq)	0.57
VA (€)/ TAP (kg SO2-Eq)	402.03
VA (€)/ODP (kg CFC11-Eq)	2,868,198.31
VA (€)/FEP (kg P-Ep)	59,300.00
VA (€)/FDP (kg oil-Eq)	1.49
VA (€)/CED (MJ)	0.05

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