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Economic analysis of wood products: system dynamics approach

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Abstract

Article is about economic analysis of promising wood products in Latvian forest sector. Three products: bio-oil, lyocell and xylan were analyzed. Currently none of the products are manufactured in Latvia. System dynamics modelling was used to determine which of the products have higher added value and which of them is more feasible. Input data for the model was taken from scientific literature and from already existing factories. It was assumed that the chosen products were manufactured as separate products, while treating the leftovers as energy source or waste. It was done to see how feasible the products are on their own. Results show that for both bio-oil and lyocell there is a positive profit value with a possibility to increase it even more in the future, while decreasing the share formed by capital costs. In case of xylan, the profit is negative, which makes xylan unprofitable. Although xylan is not feasible as a separate product, its value can be increased by manufacturing it together with other co-products, which can be obtained and manufactured from wood leftovers, therefore decreasing the specific capital costs per product and using wood in efficient manner.

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Keywords: bioeconomy; system dynamics; forest sector; added value

1. Introduction

Bioeconomy is a relatively new term, which have been widely used over recent years. There are different definitions for bioeconomy: the knowledge based use of bio-resources, based on innovative biological processes and principles,

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to provide products in a sustainable manner [1−5]; economy based on biomass for food, feed, energy and other purposes, rather than fossil-based resources [6]; the sustainable, eco-efficient transformation of renewable biological resources into food, energy and other industrial product [7]. The common thing for all of the definitions is that the renewable raw materials are used, and they are used in a sustainable and efficient manner. Important date for the bioeconomy development in Europe was the Bioeconomy Strategy adopted by European Commission in 2012 [8]. Aim of this strategy is to make more innovative, efficient and competitive society, which uses the bio-resources in a sustainable manner, both for food and industrial goals, while ensuring protection of the environment. It shows that also policy makers understand the importance of bioeconomy development.

There are in total 13 European countries who have already adopted their own bioeconomy strategies. One of them, for example, is Finland with the objective to facilitate the economic growth and employment by manufacturing high added value products from bio-resources in sustainable manner [9]. Latvia and some other countries are currently working on their own bioeconomy strategy [10].

Forest sector is one of the bioeconomy sectors, and it has very high potential. Forest sector is one of the biggest contributors to the national economy in Latvia, by forming 5.2 % of the total GDP in year 2015 [11]. It includes forestry, wood processing and furniture manufacturing. Although forest sector is big contributor in national economy, there are only few high added value products, which means there is still high potential. A lot of the forest resources are exported with little or no processing [12].

Economic evaluation of the wood products was the part of the larger research project, supported by Joint Stock Company “Latvia’s State Forests”. Aim of this research is to use the system dynamics modelling to compare three different innovative bio-products: bio-oil, lyocell and xylan derivatives, and to determine which one of them have higher added value, and whether it would be feasible to launch the manufacturing of these products in Latvia. The emphasis is on wood residues and low-quality wood.

2. Methodology

2.1. Structure

To analyze bio-product economic value, system dynamics method is used. System dynamics is the method which is used for developing and understanding models of complex real-world systems and their behavior over time [13].

Model in this research was developed in *Powersim Studio 8* software. Aim of this research was to evaluate three different products which can be produced from forest residues and other low-quality wood, and to determine which of them could be more feasible and have higher added value. Bio-oil, lyocell, i.e. textile from wood and xylan derivatives are the products which are analyzed in this research. Products were selected in the separate part of the project by using multi-criteria analysis [14].

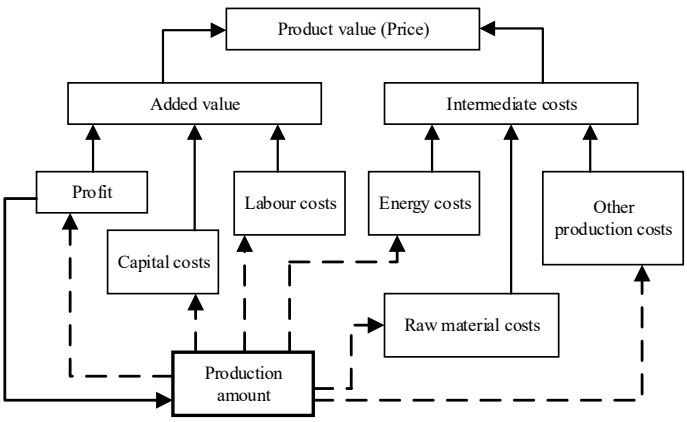

Fig. 1. Product economic value scheme.