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## The methodology for assessment of bioeconomy efficiency

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### Abstract

In order to promote an efficient development of the bioeconomy in Latvia, first, the assessment of the current situation is needed. The challenge is to compare all sectors of bioeconomy under the same terms, but at the same time to capture the diversity of different sectors of the bioeconomy. At the same time not only the comparison itself is vital, but even more - the efficiency of those sectors. Therefore to make a fair comparison two indicators are used in this study: capital productivity and labour productivity by using modified Cobb-Douglas production function. The results show that none of the bioeconomy sectors in Latvia have both a higher investment and labour intensity at the same time. The tendency of ‘buy low & sell high’ exceeds the production of goods in Latvia. The change in one sector would have impact on the whole bioeconomy therefore for further research the development of the bioeconomy should be studied as a whole system.

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*Keywords:* Cobb-Douglas production function; bioeconomy strategy; bioresource; national economy

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### 1. Introduction

More studies now focus on bioeconomy strategies for regions and countries [1], since, based on the Bioeconomy Strategy [2] bioeconomy will play major role in sustainable development. The basic principles of bioeconomy include the sustainable use of bio-resources. These bio-resources are used to produce products with as high an added value as possible. Nevertheless, to ensure an efficient and scientifically based development of bioeconomy in Latvia, we argue that, firstly, the assessment of the current situation is needed. Therefore in this study we present the methodology, which can be applied for the assessment of the initial efficiency of bioeconomy sectors.

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The challenge is to compare all sectors of the bioeconomy under the same terms, but at the same time to capture the diversity of these sectors. At the same time not only the comparison itself is vital, but more the efficiency of those sectors. Therefore to make a fair comparison two indicators are used in this study: capital productivity and labour productivity by using modified Cobb-Douglas production function. The Cobb-Douglas production function was used before to evaluate the efficiency of food industry [3], to assess technological progress [4], and to forecast greenhouse gas emissions [5]. Nevertheless, according to the authors’ knowledge, there are no studies done on the overall efficiency of the bioeconomy using the presented methodology. Therefore the main aim of this study is to present the methodology and apply this methodology for a case study on bioeconomy in Latvia. As a result of the study, the efficiency of the bioeconomy will be assessed. The obtained insight will be used for further research. The method used can be applied to study other countries and regions.

**2. Materials and methods**

The Cobb-Douglas production function was used to determine the efficiency of bioeconomy sectors in Latvia [6]. This function is expressed as the ratio of two input parameters – capital and labour, see Eq. 1.

$$Y = aL^\beta K^\alpha \tag{1}$$

where

- $Y$  total production, the value of the products and services in a year;
- $L$  labour input, number of persons employed in a year;  $K$  is capital input, the value of capital;
- $A$  total productivity factor;
- $\alpha = \beta - 1$  output elasticity of capital;
- $\beta = \alpha - 1$  output elasticity of labour.

The production function was modified to account for the efficiency of these two inputs, thus introducing labour productivity and capital productivity, see Eq. 2.

$$Y / VA = a'(L / VA)^\beta (K / VA)^\alpha \tag{2}$$

where

- $VA$  value added, given as the value added of the products and services in a year, thus  $L/VA$  defines labour productivity;
- $K/VA$  capital productivity;
- $Y/VA$  production productivity.

The graphic representation of this production function is an isoquant, see Fig. 1.

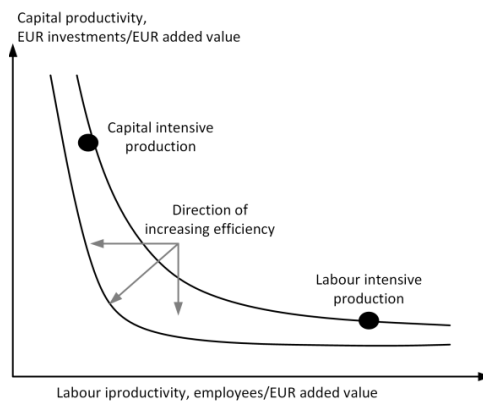


Fig. 1. Efficiency analysis used for the bioeconomy using the Cobb-Douglas production function.

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