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Eco-efficiency assessment of Polish regions: joint application of life cycle assessment and data envelopment analysis

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Abstract
This article examines the concept of eco-efficiency at a regional level as an approach to promote the sustainable transformation of regions, using the regions of Poland as an example. The combined application of Life Cycle Assessment (LCA) and Data Envelopment Analysis (DEA) – the input-oriented BCC (Banker/Charnes/Cooper) model – has been chosen as a tool for the comprehensive eco-efficiency assessment, due to its high capability to measure regional eco-efficiency. The ultimate goal of this approach is to support the strategic decision-making process. The research brings numerous findings. Firstly, it exposes that four (Mazowieckie, Podlaskie, Warmińsko-Mazurskie and Wielkopolskie) of the sixteen Polish regions are being relatively eco-efficient. Certainly, the fact that agriculture and services contribute the most to the creation of GDP in these regions has an influence on the achieved results. Secondly, the study proves that Śląskie region, having the most detrimental impact on the environment in all areas of protection, i.e. human health 0.127 DALY·ha⁻¹, ecosystems 0.000557 SPECIES.YR·ha⁻¹ and resources 3009 $·ha⁻¹, is the most eco-inefficient. The causes of the observed eco-inefficiency of Polish regions are also explored, with the conclusion that the fundamental ones are cumulative airborne emissions (primarily carbon dioxide) and the excessive consumption of fuels, energy and heat in relation to the produced value of goods and services. Finally, heavy industry remains a basic source of environmental pressure and thus the decision makers ought to pay greater attention to the implementation of the best available techniques.

Keywords: data envelopment analysis (DEA), environmental-economic indicators, life cycle assessment (LCA), regional eco-efficiency, Poland
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