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MULTICRITERIA INPUT OR OUTPUT DATA ENVELOPMENT ANALYSIS (DEA) METHOD FOR ENVIRONMENTAL EFFICIENCY EVALUATION IN THE CONTEXT OF WASTE SEPARATION SYSTEMS

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Abstract

Environmental efficiency analysis plays a crucial role in achieving a balance between economic development and environmental protection, ultimately leading to sustainable development. While Data Envelopment Analysis (DEA) serves as a conventional tool for efficiency analysis, its traditional methodology confines analysis to a single perspective. To enhance the comprehensiveness of environmental efficiency analysis, this study combines the DEA model with multi-criteria decision analysis, yielding a multicriteria efficiency evaluation method. This approach mitigates the unilateral nature of evaluation outcomes arising from a singular standard. Additionally, the Principal Component Analysis (PCA) method is integrated into the framework to address the challenges associated with high-dimensional and non-homogeneous data. By incorporating the multicriteria decision making method, the new approach overcomes the limitations of traditional DEA methods, which struggle with the analysis of high-dimensional and non-homogeneous data. The proposed method facilitates the seamless transition between multiple evaluation criteria within the same evaluation system, enabling flexibility and adaptability in assessing efficiency. To demonstrate the practicability of the proposed method, a case study focusing on the efficiency analysis of block waste separation in China city is conducted. The study detected fluctuations in the environmental efficiency of identical decision-making units under diverse evaluation standards, attributing these variations to the different emphases of the evaluation criteria. The findings underscore the efficacy of the new method in providing decision-makers with a unified efficiency analysis paradigm. This paradigm enables a comprehensive consideration of environmental efficiency improvements across various levels and perspectives, accommodating different priorities in local decision-making.

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