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YST024 - ECOTOPSIS: A BIG DATA APPROACH FOR SUSTAINABLE EVALUATION AND RANKING

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ABSTRACT

This study introduces EcoTOPSIS, a web-based decision support tool designed for sustainability project evaluation under the theme *"Celebrating Innovation, Commercialisation and Publication."* The system employs the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to rank alternatives, enabling users to upload datasets, define benefit and cost criteria, assign weights, and obtain step-by-step outputs with visualizations. By integrating big data processing with automated computation, EcoTOPSIS enhances efficiency, accuracy, and transparency compared to traditional manual Multi-Criteria Decision-Making methods. Its interactive platform supports reproducibility, provides downloadable results, and offers practical applicability in areas such as project selection, technology adoption, and resource allocation. The tool effectively bridges the gap between theoretical models and real-world applications, reduces bias and computational errors, and facilitates evidence-based decision-making aligned with sustainable development objectives.

Keywords – Big data analytics, Decision support systems, Multi-Criteria Decision-Making, Sustainability evaluation, TOPSIS method

INTRODUCTION

The rapid growth of sustainability initiatives has introduced increasingly complex decision-making challenges, where multiple environmental, economic, and social criteria must be evaluated simultaneously. Traditional project evaluation and ranking approaches often rely on manual Multi-Criteria Decision-Making (MCDM) methods, which are time-consuming, prone to computational errors, and unsuitable for handling large datasets. These limitations hinder transparent and data-driven decision-making, particularly in contexts that demand quick assessments and reproducible results.

Recognizing this gap, EcoTOPSIS was developed as an interactive, web-based decision support tool. The motivation behind the creation of EcoTOPSIS lies in addressing three key challenges: the inefficiency of manual computations, the lack of transparency in conventional ranking processes, and the need for a scalable platform capable of integrating big data in sustainability evaluations. By automating the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method and visualizing each step of the evaluation process, the system provides a reliable, user-friendly, and academically

robust solution for researchers, policymakers, and organizations seeking evidence-based decision-making in sustainable project selection and resource allocation. Hwang and Yoon proposed the method in 1981, and it has been used extensively in socioeconomic studies, in scientific studies, and by policy analysts (Zhang et al., 2017).

OBJECTIVES

The development of EcoTOPSIS: A big data approach for sustainable evaluation and ranking is guided by the following objectives:

i. To design and implement a web-based decision support tool that applies the TOPSIS method to automate the evaluation and ranking of alternatives based on multiple sustainability-related criteria.
ii. To integrate big data handling capabilities that enable rapid, accurate, and scalable evaluations, reducing the limitations of manual computation and supporting evidence-based decision-making.

DESCRIPTION OF THE PROJECT

EcoTOPSIS is an interactive, web-based decision support tool developed to streamline the process of MCDM for sustainability-focused projects. The system was built using Python and Streamlit, enabling real-time computations and user interactivity. Its primary objective is to automate the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, allowing users to evaluate multiple alternatives against several benefit and cost criteria with enhanced transparency and efficiency. Users can upload datasets in Excel or CSV formats, assign weights to criteria, specify their types (benefit or cost), and instantly visualize the results without performing manual calculations. The website is accessed through the link : https://ecotopsis-harrisf.streamlit.app/.

Functionally, EcoTOPSIS integrates step-by-step TOPSIS computation with features that include vector normalization, weighted normalization, identification of Positive and Negative Ideal Solutions (PIS and NIS), and calculation of Euclidean distances and closeness coefficients. The system automatically generates ranked outputs, which can be explored through interactive visualizations such as bar charts and line plots. Additionally, users can download final rankings in CSV or Excel formats, enabling further analysis and documentation. By incorporating big data capabilities, the tool can handle datasets with a large number of criteria and alternatives, supporting research and decision-making processes that demand both speed and accuracy. By simplifying complex evaluations and providing real-time ranking insights, the platform supports evidence-based resource allocation and strategic planning. The workflow of EcoTOPSIS is illustrated in Figure 1, highlighting its seamless process from dataset upload to final ranking visualization and report generation.

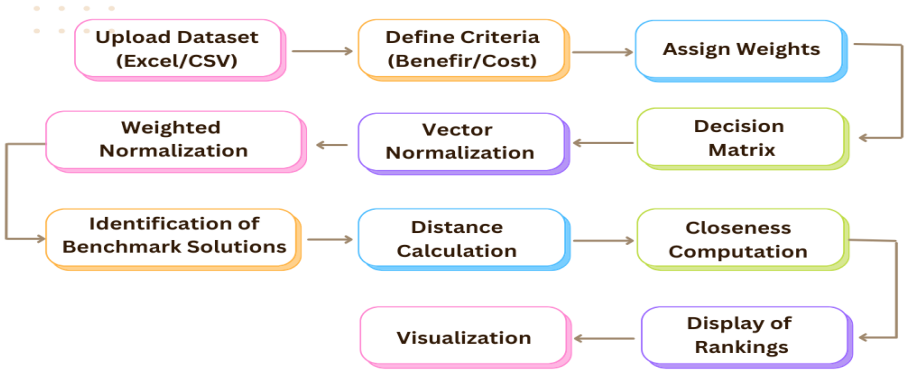

Figure 1:Flowchart of EcoTopsis

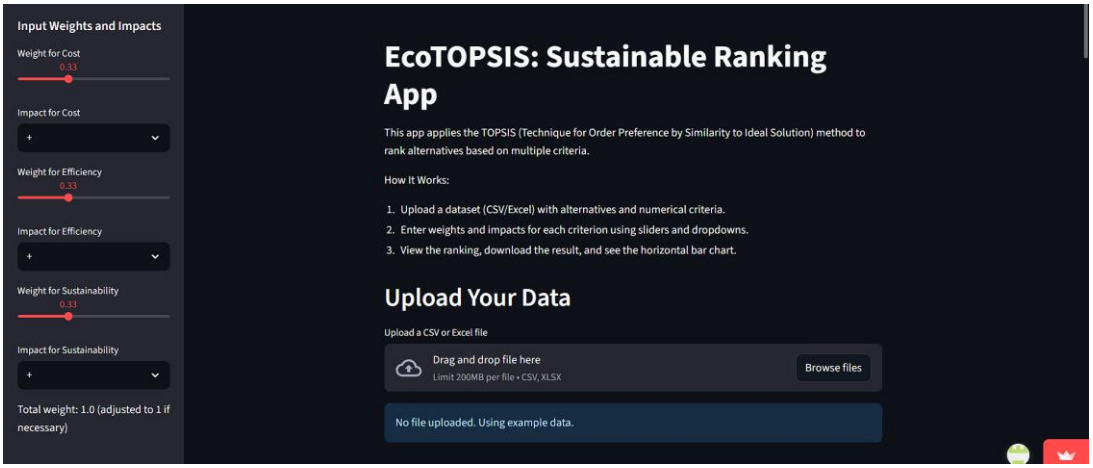

Figure 2: EcoTopsis interface

NOVELTY

The novelty of EcoTOPSIS lies in its seamless integration of big data capabilities, automated TOPSIS computation, and interactive visualization within a single, accessible web-based platform.TOPSIS showed that it not only helped complex decisions but also acted as a reliable system for offering recommendations (Cheng et al., 2018). Unlike traditional MCDM tools that depend on manual calculations or static spreadsheets, EcoTOPSIS offers a fully automated workflow that performs normalization, weighting, distance calculations, and ranking in real time, enabling efficient analysis of large datasets while minimizing human error and ensuring transparency through step-by-step outputs. By combining data processing, computation, and visualization with downloadable results and interactive charts, it bridges academic models with practical applications, delivering a scalable, user-friendly, and reproducible decision-support tool for sustainable, data-driven policymaking and innovation.

CONCLUSION

EcoTOPSIS overcomes the limitations of conventional decision-making tools by offering a transparent, efficient, and scalable web-based platform for multi-criteria evaluations. Automating the TOPSIS method, it unifies dataset processing, weight assignment, normalization, distance computation, and ranking with interactive visualizations and

downloadable results. Its big data handling and real-time computation enhance practicality, reduce human error, and ensure reproducibility. By integrating automation, visualization, and user interactivity, EcoTOPSIS bridges theory and practice in sustainability evaluations. This innovative tool supports researchers, policymakers, and organizations in data-driven, evidence-based decision-making, advancing digital MCDM solutions that promote innovation, commercialization, and sustainable development across diverse evaluation contexts.

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