

ABSTRACT

Purpose This study aims to develop an AI-based Decision Support System (DSS) to enhance the supplier selection process for Sustainable Aviation Fuel (SAF) procurement. By integrating predictive analytics and multi criteria evaluation, the research addresses the growing need for reliable, sustainable, and adaptive SAF supply chain management.

Design/methodology/approach A hybrid methodology was employed, combining structured data preprocessing, feature selection using Random Forest Importance and Recursive Feature Elimination (RFE), and the development of three predictive models: Decision Tree (C5.0), Random Forest, and XGBoost. Secondary data comprising SAF feedstock supplier records were collected from FAOSTAT and ICAO Environment databases. Scenario-based testing (S1–S5) was conducted to evaluate the models under varying combinations of economic, environmental, technological, and operational features. Model performance was assessed using Accuracy, Precision, Recall, and F1-Score metrics.

Findings XGBoost consistently achieved the highest predictive performance, with an accuracy of 93.02% under the full multi criteria scenario (S4), followed closely by Random Forest. Decision Tree models, while interpretable, exhibited lower accuracy and a greater tendency toward overfitting. Scenario analysis highlighted the critical role of multi-dimensional evaluation in enhancing supplier classification performance, and the removal of key economic features (such as Minimum Selling Price) significantly reduced model effectiveness.

Originality/value This study extends the application of Machine Learning to the SAF procurement domain, offering a novel predictive framework that integrates economic, environmental, and technological considerations for supplier evaluation. The AI-based DSS provides a practical solution for advancing sustainability and resilience in SAF supply chains, offering actionable insights for procurement decision makers seeking data driven and adaptive strategies.

Key Words: Sustainable Aviation Fuel (SAF), Supplier Selection, AI-Based Decision Support System, Multi Criteria Evaluation, Machine Learning Classification