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MACHINE LEARNING APPROACH FOR PREDICTING ENVIRONMENTAL IMPACT: A NEURO-FUZZY MODEL FOR LIFE CYCLE IMPACT ASSESSMENT OF STRAWBERRY PRODUCTION

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Abstract – Artificial Intelligence (AI) is transforming traditional methods reliant on human knowledge by introducing machine learning techniques, which offer effective solutions for complex challenges. An example of such a case is the evaluation of the environmental impacts of products throughout their lifecycle. This study bridges the gap in life cycle assessment (LCA) by leveraging AI to predict environmental impacts in agriculture, specifically using LCA data from one cultivation system to model another. We employed Adaptive Neuro-Fuzzy Inference Systems (ANFIS) to predict CO₂ equivalent emissions for open-field strawberry production, utilizing greenhouse strawberry data. The novelty lies in combining machine learning with LCA to address data scarcity and improve predictive accuracy in agricultural impact assessments. The model was trained with data generated in MATLAB and validated against emissions computed using the Ecoinvent 3.10 database and SimaPro software. Among the three fuzzy inference system (FIS) generation approaches – Fuzzy C-Means (FCM), Subtractive Clustering (SC), and Grid Partitioning (GP) – FCM exhibited the highest accuracy. This methodology showcases AI's potential to transform LCA, enabling more efficient, data-driven sustainability assessments.

Keywords – ANFIS; artificial intelligence; carbon footprint; global warming potential; sustainability