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Spatial Decision Support System to Evaluate Crop Residue Energy Potential by Anaerobic Digestion¹

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Abstract

Implementing anaerobic digestion (AD) in energy production from crop residues requires development of decision tools to assess its feasibility and sustainability. A spatial decision support system (SDSS) was constructed to assist decision makers to select appropriate feedstock according to biomethanation potential, identify the most suitable location for biogas facilities, determine optimum plant capacity and supply chain, and evaluate associated risks and costs. SDSS involves a spatially explicit analysis, fuzzy multi-criteria analysis, and statistical and optimization models. The tool was validated on seven crop residues located in Santander, Colombia. For example, fique bagasse generates about 0.21 million $\text{m}^3 \text{CH}_4 \text{ year}^{-1}$ (0.329 $\text{m}^3 \text{CH}_4 \text{ kg}^{-1}$ volatile solids) with a minimum profitable plant of about 2000 ton year^{-1} and an internal rate of

¹ AD: anaerobic digestion; ADM1: Anaerobic Digestion Model No. 1; BP: biomass point; BSW: banana stem waste; FAHP: Fuzzy analytic hierarchy process; IBD: index of biomass dispersion; IRR: internal rate return; LHV: lower heating value; COD: chemical oxygen demand; PEFB: palm empty fruit bunches; NPV: net present value; PLSR: partial least squares regression; RPR: residue-to-product ratio; SDSS: spatial decision support system; TS: total solids; VS: volatile solids.

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