

Digital carbon emission accounting and economic evaluation for effective agricultural waste management

Effective agricultural waste management requires precise carbon emission accounting and economic evaluation to support informed decision-making by farmers, agricultural cooperatives, biorefinery operators, and environmental policymakers. We have developed an intelligent, automated system, capable of handling the intricate calculations required for assessing agricultural waste-to-value conversion projects.

Project activity

The approach taken involved:

- Developing Python-based, analytical software with a graphical, user-friendly interface (GUI).
- Integrating 13 distinct carbon emission calculation models (covering: fossil fuel combustion nitrogen oxide emissions, manure fermentation, wastewater treatment purchased electricity/heat, industrial/municipal wastewater, solid waste management, and distiller's grain fermentation).
- Creating economic evaluation modules for cost analysis, revenue calculation, profit analysis, and return on investment (ROI).
- Implementing sensitivity analysis functionality to assess how key factors affect economic viability.
- Designing automated reporting features (charts, graphs and exportable data tables).
- Enabling Excel data integration.



The software reduces the calculation time for carbon accounting of complex agricultural waste projects from days to minutes and improves accuracy by around 95%.

Sensitivity analysis reveals product pricing and raw material costs to be the most critical factors affecting project viability, with SAF (Sensitivity Analysis Factor) values typically ranging from 0.8-1.2.

Integrated economic-environmental analysis reveals hidden opportunities where waste conversion can be optimised.

Automated data visualization makes complex data accessible to non-technical stakeholders and improves their understanding and acceptance of complex technical data.

Key findings and recommendations

The software developed highlights the transformative role of digital tools in carbon accounting and economic evaluation for agricultural waste management.

- Faster and more accurate at carbon accounting
- More accessible to non-technical stakeholders
- Enables quicker, better decision-making through real-time scenarios, sensitivity analysis and integrated economic-environmental analysis.
- Widely applicable, with modular software design making it easily adaptable to different agricultural waste streams, regional specificities and scales.

References

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For more information about
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agriloop-project.eu



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AgriLoop Project Deliverables on agricultural waste valorization

IPCC Guidelines for National Greenhouse Gas Inventories (2006)

European Union Best Available Techniques Reference Documents

Relevant publications in Bioresource Technology, Journal of Cleaner Production, and Chemical Engineering Journal



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