

# Prakash Singh, PhD

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## Software

- SimaPro: A Life cycle Assessment Tool
- Oracle Crystal Ball: Uncertainty and Sensitivity Analysis

## Experience

### Project Scientist

Dec 2024 to Current

#### Indian Institute of Science Bangalore - Karnataka

- Currently developing the cradle-to-grave life cycle assessment (LCA) framework for Solid Waste Management Technologies in India, sponsored by the Office of the Principal Scientific Advisor (PSA) to the Government of India.
- A comprehensive material flow analysis (MFA) of a 6200 tons per day (TPD) municipal solid waste (MSW) in Bangalore has been performed, tracking material movement from collection to final disposal. Similarly, MFA of cities like Mysore and Puttur has been performed.
- LCA study of Biogas plant for flaring (13 kg CO<sub>2</sub>/ton), electricity generation (-123 kg CO<sub>2</sub>/ton), direct cooking (-108 kg CO<sub>2</sub>/ton), and vehicle fuel (-11 kg CO<sub>2</sub>/ton);
- Composting plant (With and without energy recovery from leachate), compost plants have carbon footprint of -1.2 kg CO<sub>2</sub>/ton of OFMSW.
- Waste to energy plant without CO<sub>2</sub> capture (56 kg CO<sub>2</sub>/ton), with CO<sub>2</sub> capture and storage (-712 kg CO<sub>2</sub>/ton), and with CO<sub>2</sub> capture and utilization (-687 kg CO<sub>2</sub>/ton),
- Material recovery facility and Recycling
- Landfill (baseline and with landfill gas capture and leachate recirculation) is being performed.
- For Bio-CNG plants (large scale plants with payback <5 years), composting plants (not economically feasible with current operation, however biogas capture from leachate could make it feasible), and waste to energy plants (payback < 6 years for high calorific value waste) has been identified.
- 1 first author manuscript published and 2 in review

## Research Interest

- Anaerobic digestion
- Waste Management
- Techno-Economic Assessment
- Life cycle Assessment
- Carbon footprint Estimation

## Education

### Doctor of Philosophy, School of Agro and Rural Technology

(July 2019 - March 2025)

#### Indian Institute of Technology Guwahati - Guwahati, AS

Exempted from coursework

Dissertation Title: Unleashing India's Biogas Potential: A Multi-Faceted Approach (8 first author publication, 2 in review)

#### Summary of Work:

1. The findings show India's biogas potential to be 75 billion m<sup>3</sup> per year and current utilization is less than 5% of it.
2. Assessment of biogas in different sectors such as cooking, electricity, and vehicle fuel was performed. The findings show
  - (a) Biogas could supply 321 PJ of useful energy for cooking from livestock waste, 75444 GWh of electricity from agricultural residue, and replace 1.4 million tonnes diesel equivalent from MSW and wastewater.

- (b) Carbon footprint of biogas as cooking fuel is 107 g CO<sub>2</sub> eq./MJ<sub>useful</sub>; biogas for electricity generation is 909 g CO<sub>2</sub> eq./kWh<sub>useful</sub>; biogas as a vehicle fuel is 105 g CO<sub>2</sub> eq./km.
3. Since the utilization of biogas was less than 5%, Identification and ranking of the barriers in the dissemination of biogas plants using AHP and Fuzzy AHP approach was done. Also, different mitigation was purposed to overcome the most prominent barriers.
  4. Biogas production from rice straw, sugarcane bagasse, and wheat is significantly influenced by storage. 1.44-fold increase for RS, 29% reduction for SB, and 1.32-fold increase for WS was observed during storage period.
  5. Increase of 48%, 5.4%, and 24.38% in methane yield respectively was observed for rice straw pellets (RSP), sugarcane bagasse pellets (SBP), and wheat straw pellets (WSP). Reduce the demand for storage capacity, transit, and thus expenses.
  6. Further increase of 30.3%, 23.7%, and 27.7% respectively was observed for pretreated RSP, SBP, and WSP. Ready to feed material was developed.
  7. LCA study of bio-CNG generation through various routes was performed. Pelletization (with and without pretreatment) resulted in higher methane yield and high bulk density without additional environmental impacts (almost decrease of 3% GWP).

**M.Tech, School of Agro and Rural Technology**  
**Indian Institute of Technology Guwahati - Guwahati, AS**  
CGPA 9.56/10

July 2017 - July 2019

Dissertation Title: Anaerobic digestion of food waste generated at hostels of IIT Guwahati

**B.Tech., Mechanical Engineering**  
**Sir Padampat Singhania University - Udaipur, Rajasthan**  
Percentage - 71.29

July 2011- July 2015

## **Publications (Journal- Peer Reviewed)**

- **Singh, P., Babu, GLS., Hoysall C., and Rao LN., 2025** Assessing biogas valorization from municipal organic waste in India: Integrated environmental-economic analysis. *Bioresource Technology*, pp. 1-17. (IF: 9.0)  
<https://doi.org/10.1016/j.biortech.2025.133675>
- **Singh, P. and Kalamdhad A.S., 2024.** Unravelling barriers associated with dissemination of large-scale biogas plant with analytical hierarchical process and fuzzy analytical hierarchical process approach: Case study of India. *Bioresource Technology*, pp. 1-11.  
<https://doi.org/10.1016/j.biortech.2024.131543>
- **Singh, P., Dogra, P. and Kalamdhad A.S., 2024.** Effects of pelletization on biomethane production from wheat straw. *Environmental Technology* 1-12.  
<https://doi.org/10.1080/09593330.2024.2359095>
- **Singh, P., Dogra, P., TG, I. and Kalamdhad A.S., 2024.** Co-densification of rice straw and cow dung in different food-to-microorganism ratios for biogas production. *Scientific Reports* 14 (1).  
<https://doi.org/10.1038/s41598-024-52122-3>
- **Singh, P., Dogra, P. and Kalamdhad A.S., 2024.** Sugarcane bagasse and cow dung pelletization in varied food-to-microorganism ratios for biogas generation. *Industrial Crops and Products* 210.  
<https://doi.org/10.1016/j.indcrop.2024.118120>
- **Singh, P. and Kalamdhad A.S., 2022.** Assessment of agricultural residue-based electricity production from biogas in India: Resource-environment-economic analysis. *Sustainable Energy Technology and Assessment* 54. <https://doi.org/10.1016/j.seta.2022.102843>
- **Singh, P. and Kalamdhad A.S., 2022.** Assessment of small-scale biogas digesters and its impact on the household cooking sector in India: Environmental-resource-economic analysis. *Energy for Sustainable Development* 70, pp. 170-180. <https://doi.org/10.1016/j.esd.2022.07.018>
- **Singh, P. and Kalamdhad A.S., 2022.** Biomethane plants based on municipal solid waste and wastewater and its impact on vehicle sector in India-An Environmental-economic-resource assessment. *Environmental Technology & Innovation* 26, pp. 1-17.  
<https://doi.org/10.1016/j.eti.2022.102330>

- Singh, P. and Kalamdhad A.S., 2021. A comprehensive assessment of state-wise biogas potential and its utilization in India. Biomass Conversion and Biorefinery, pp. 1-23. <https://doi.org/10.1007/s13399-021-02001-y>
- Saha, B., Sathyan, A., Singh, P., Kalamdhad, A.S., Khwairakpam, M. Prerequisite of electrohydrolysis pretreatment on lignocellulose terrestrial weed (*Ageratum conyzoides*) to enhance the methane production and continuous reactor study. Materials Science for Energy Technologies 3, 896-904

## Conferences

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- Singh, P., Kalamdhad A.S (2023). Scope and challenges of biogas technology in India. Paper presentation in Recycle'23 (International conference on waste management) held on May 18-19 at Indian Institute of Technology Guwahati.
- Singh, P., Kalamdhad A.S (2020). Assessment of biogas potential in India. Paper presentation in Recycle'20 (International conference on waste management) held on Feb 13-14 at Indian Institute of Technology Guwahati.

## Accomplishments

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- Best Ph.D. Thesis Award 2025 (IIT Guwahati)
- Singh, P., Kumar, A. and Kalamdhad, A.S., 2019. Biogas generation through anaerobic digestion of food waste and its purification. Proc. Fourth International Conference on Sustainable Energy & Environmental Challenges (SEEC 2019), 27-29 Nov., National Environmental Engineering Research Institute (NEERI), Nagpur, India. (Best poster)
- Qualified Graduate Aptitude Test in Engineering (GATE), 2017.

## Positions of Responsibility

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- Organizing Member of the workshop on Issues and Challenges in the Implementation of Extended Producer Responsibility (EPR) for sustainable solid waste management held at IISc Bangalore (Jan 2025)
- Organizing Member 2nd/3rd/4th International Conference on Waste Management (Recycle 2018/2020/2023) held at IIT Guwahati.
- Student Lab In-charge Solid Waste lab (IIT Guwahati) and Student member for Green office (IIT Guwahati)

## References

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| <ul style="list-style-type: none"> <li>• Dr. Ajay Kalamdhad (Professor)<br/>Department of Civil Engineering<br/>Indian Institute of Technology Guwahati<br/>kajay@iitg.ac.in<br/>+91 361-258 2431, +91 9678621395</li> </ul>                      | <ul style="list-style-type: none"> <li>• Dr. G L Shivkumar Babu (Professor)<br/>Department of Civil Engineering<br/>Indian Institute of Science Bangalore<br/>gls@iisc.ac.in<br/>+91 944848067</li> </ul>        |
| <ul style="list-style-type: none"> <li>• Dr. Meena Khwairakpam (Associate Professor)<br/>School of Agro and Rural Technology<br/>Indian Institute of Technology Guwahati<br/>meena.kh@iitg.ac.in<br/>+91 0361-258 3798, +91 8471845605</li> </ul> | <ul style="list-style-type: none"> <li>• Dr. Vaibhav V. Goud (Professor)<br/>Department of Chemical Engineering<br/>Indian Institute of Technology Guwahati<br/>vvgoud@iitg.ac.in<br/>+91 361 2582272</li> </ul> |