Academic Assessment of Global Biogas Potential from Cattle and Buffalo Dung Using a 50% Methane Recovery Baseline

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Abstract: ***This academic study estimates the global and regional biogas potential from cattle and buffalo dung using a 50% methane-content baseline. Global livestock data (1.57 billion cattle and 205 million buffaloes) and published manure yield factors were applied to quantify dung production and theoretical biogas yield. Results indicate approximately 6.63 billion tonnes of dung annually, capable of generating about 198.9 billion m³ of biogas, equivalent to 77 million tonnes of liquefied petroleum gas (LPG). This potential could theoretically replace around 50% of global domestic LPG consumption. Present biogas output (approximately 40 billion m³ natural gas equivalent per year) remains far below this potential, revealing substantial untapped renewable energy within livestock systems. The findings emphasize the role of manure-based biogas in reducing fossil LPG dependence, strengthening rural energy security, and supporting climate-smart agriculture and circular economy strategies.***

Keywords: biogas potential, livestock waste, renewable energy, methane production, climate-smart agriculture

1. Introduction

Livestock production systems generate vast amounts of organic waste, particularly dung and slurry. While traditionally seen as fertilizer, this biomass can be a major renewable energy source when processed through anaerobic digestion. Biogas-composed primarily of methane (CH_4) and carbon dioxide (CO_2)-is suitable for domestic cooking, electricity generation, and heat energy. Cattle and buffaloes, together accounting for a large share of global ruminant populations, produce enormous quantities of manure. Estimating the theoretical biogas output from these animals is critical for understanding renewable energy opportunities within agricultural systems. This study assesses the potential biogas volume generated from global cattle and buffalo populations, applies a 50% methane-content baseline for conversion, and evaluates its equivalence to LPG consumption for domestic use worldwide.

2. Materials and Methods

Population data for cattle and buffaloes were obtained from the Food and Agriculture Organization (FAO, 2024) and Our World in Data (2024). Average dung generation rates were set at 10 kg/day for cattle and 12 kg/day for buffaloes. A methane generation factor of 15 m³ CH_4 per tonne of fresh dung and a 50% methane-content baseline for biogas were used. LPG equivalence was calculated using a lower heating value of 17.9 MJ/m³ for biogas and 46 MJ/kg for LPG, with domestic LPG consumption estimated at 154 million tonnes annually.

3. Results

Table 1: Global Dung and Biogas Potential

Parameter	Cattle	Buffalo	Combined
Population (million)	1,570	205	1,775
Dung (billion tonnes/year)	5.73	0.90	6.63
Biogas (billion m³/year)	172.0	26.9	198.9
LPG Equivalent (million tonnes)	67.0	10.4	77.4
Domestic LPG Replacement (%)	43.5	6.8	50.3

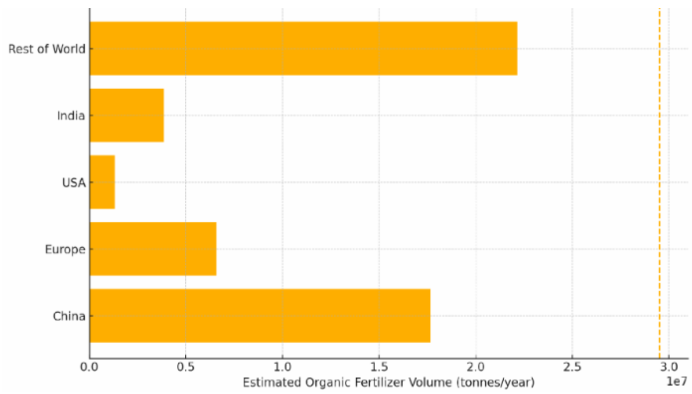

Figure 1: Regional LPG Replacement Potential from Cattle & Buffalo Biogas (50% CH_4 Baseline)

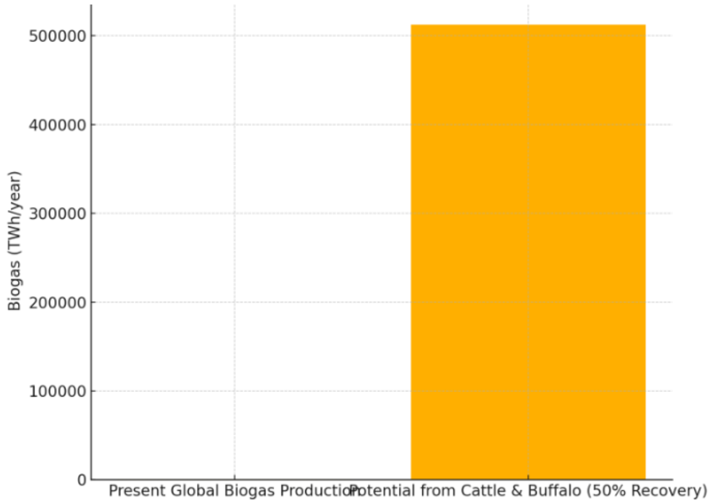

Figure 2: Present vs Potential Global Biogas Production

4. Discussion

The analysis shows that livestock manure represents a significant yet underutilized renewable energy resource. Asia holds nearly two-thirds of the potential due to dense livestock populations, especially in India, China, and Pakistan. Even partial recovery could transform rural energy access, reducing fossil fuel reliance and promoting sustainable agriculture. Policy support for decentralized anaerobic digesters, carbon credits, and cooperative energy schemes would strengthen adoption.

India currently has 5.1 million of biogas plants installed with the majority of them having a capacity of 1-25 m3/day. Further detailed studies on the total cost models could provide us the required direction to utilise this potential to at least 50% of its theoretical capacity.

5. Conclusion

At a 50% methane-content baseline, global cattle and buffalo dung can yield approximately 198.9 billion m^3 of biogas annually, equivalent to 77 million tonnes of LPG. This volume could replace about 50% of current global domestic LPG consumption. With only 40 billion m^3 currently produced worldwide, the unused potential is vast, demonstrating the importance of livestock waste valorization in global renewable energy strategy. Further practical trial based studies are required to find out the practical challenges for a large scale implementation.

Conflict of Interest & Funding

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The author declares no conflict of interest.

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