

Methane emissions from dairy farms



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Potential for Agricultural AD in India

Biogas from cattle dung

Total bovine population (2003) : 272 million

Yearly dung production (@12 kg/day/animal) = 1191.3 million tons

Yearly gas production (@30 lit/kg) : 35739 million m³ /annum



Biogas potential

Biogas from poultry litter

Total poultry population (1997) : 347 million

Yearly dung production (@ 200 g/bird) : 25 million tons

Yearly gas production (@ 116 l/kg) : 2938 million m³/ annum

Total gas production : 19.34 mtoe (387 mtoe total for India)

Dairy farms

- Smaller farms with 10-100 cattle heads with traditional milking facility
- Location of dairy farms close to several modern milking parlor set – ups housing 1500 or 2000 cattle.
- The size and concentration of cattle in small and large ones has major environmental issues due to manure handling and disposal.



DISPOSAL TECHNIQUES OF WASTE

Anaerobic digester

Common techniques

- Store solid waste in pond
- Anaerobic lagoon
- Burn dung as fuel



Advanced techniques

- Anaerobic digestion
- Composting



Composting





Waste constituents

- Soil, suspended solids, stones, manure, cow dung, cow hair, urine, mucus, milk, yard and plant washing water storm water, detergent, Chemical residue



Selection of Dairy farms

- The survey was conducted mainly on the outskirts of UP state i.e. Ghaziabad, Meerut city and in the interior villages of the Modinagar town
- 8 Units chosen for the analysis
 - Three registered run by charitable trust and four non-registered (small scale at home and large ones).
 - Difference in the adoption of waste management system and the disposal technique.



Parameters for emissions

- Population
- Ultimate methane yield
- Volatile solid generation rates
- Methane conversion factors
- Type of disposal system
- Utilisation of biogas



Factors for Indian subcontinent

- $B_0 = 0.13 \text{ m}^3 \text{ CH}_4/\text{kg VS}$
(value for Indian subcontinent)
VS = 2.6 kg/head/day
- MCF (for Warm regions)
 - Solid storage method – 5%
 - Dry lot – 2%
 - Liquid/slurry- 50% (without cover), 80 % (with cover)
 - Uncovered anaerobic lagoon – 80%
 - Pit storage - 30% (<1 month) and 80% (> 1 month)



Factors

- Anaerobic digester – 0-100%
- For fuel – 10%
- Cattle and swine (deep bedding) – 30% (< 1 month) and 80% (> 1 month)
- Composting
 - In vessel – 0.5%
 - Static pile – 0.5%
 - Windrow – 1.5%
 - Passive windrow – 1.5%



Methane conversion factor in case of anaerobic digester

- $$\text{MCF} = \left[\frac{\{\text{CH}_4 \text{ prod} - \text{CH}_4 \text{ used} - \text{CH}_4 \text{ flared} + (\text{MCF}_{\text{avg}}/100 * B_0 * VS_{\text{avg}} * 0.67)\}}{(B_0 * VS_{\text{avg}} * 0.67)} \right] * 100$$



Methane emission template

A. Animal type	B. Standing animal population	C. VS volatile solid Kg/hd/day	D. Total VS (Kg/day) $b*c$	E. Bo ultimate methane yield/dairy m^3/day	F. Ultimate methane yield/dairy $e=m^3/day$	G. MCF methane conversion factor	H. Estimated emissions $(f*g)*0.0657Kg/m^3*365 days/yrs.$
1. Cows lactating							
2. Cow dry							
3. Heifers							



Case study -1

- Location : Gopal Gaushala, Meerut, UP
- Capacity : 450 litre/day from 300 head
- Waste handling system
 - Liquid storage
 - Anaerobic digester
 - Vermicomposting
 - Direct use as fuel
- Total emissions (Kg/year) : 440
 - Composting : 3
 - Liquid storage : 304
 - Anaerobic digester : 72
 - Fuel: 61

Assumptions: 25% of total waste managed by each method



Case study 2

- Location : Modi Gaushala (1), Ghaziabad, UP
- Capacity : 250 litre/day from 60 head
- Waste handling system
 - Solid storage
 - Vermicomposting
 - Land application
- Total emissions (Kg/year) : 12.6 kg
 - Composting : 1.1
 - solid storage : 11
 - Land application :0.5

Assumptions: 45% of total waste managed by composting and solid storage, 10% by land application



Case study 3

- Location : Modi Gaushala (2), Modinagar, UP
- Capacity : 350 litre/day for 100 head
- Waste handling system
 - Solid storage
 - Land application
 - Fuel
- Total emissions (Kg/year) : 138
 - solid storage : 45
 - Land application : 2
 - Fuel : 91

Assumptions: 45% of total waste managed by burning and solid storage, 10% by land application



Controlled waste management

- Case study 4
- Location : Tyagi Dairy, Modinagar, UP
- Capacity : 225 litre/day for 30 head
- Waste handling system
 - Land application
 - Anaerobic digester(controlled storage condition)
- Total emissions (Kg/year) : 0.24
 - Land application : 0.24
 - Anaerobic digester : 0

Assumptions: 90% of total waste managed by anaerobic digestion
and 10% by land application



Comparison of emissions

- Case study 1 : 1.46 kg/head
- Case study 2 : 0.21 kg/head
- Case study 3 : 1.38 kg/head
- Case study 4 (controlled anaerobic condition) : 0.01 kg/head