# Methane emissions from dairy farms

## V V N Kishore, K V Rajeshwari, TERI, Delhi Nidhi Ahuja, Gurukul University, Hardwar

#### **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 m<sup>3</sup> /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 m<sup>3</sup>/ annum

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

# Dairy farms

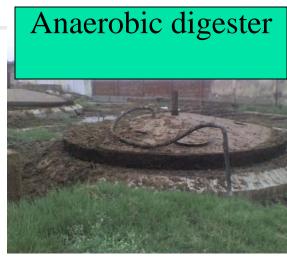
- Smaller farms with 10-100 cattle heads with traditional milking facility
- Location of dairy farms close to several modern milking parlor set – ups housing 1500 or 2000 cattle.
- The size and concentration of cattle in small and large ones has major environmental issues due to manure handling and disposal.



#### **DISPOSAL TECHNIQUES OF WASTE**

- Common techniques
- Store solid waste in pond
- Anaerobic lagoon
- Burn dung as fuel
- Advanced techniques
- Anaerobic digestion
- 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<sub>0</sub> = 0.13 m<sup>3</sup> CH<sub>4</sub>/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

MCF = [{CH<sub>4</sub> prod-CH<sub>4</sub> used-CH<sub>4</sub> flared + (MCF<sub>avg</sub>/100\*B<sub>o</sub>\*VS<sub>avg</sub>\*0.67)}/(B<sub>0</sub>\*VS<sub>avg</sub> \*0.67)]\*100

#### Methane emission template

A. Animal type	B. Standing animal populati on	C. VS volatile solid Kg/hd/d ay	D. Total VS (Kg/da y) b*c	E. Bo ultimate methane yield/dairym3/ day	F. Ultimate methane yield/dairy*e=m3/ day	G. MCF methane conversi on factor	H. Estimated emissions (f*g)*0.0657Kg /m 3*365 days/ yrs.
1. Cows lactatin g							
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