Biogas Manure (BgM) use as a viable input in sustainable agriculture – an integrated approach

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Kanyakumari, Tamil Nadu, India

Biogas plants: Realized potential

• Biogas dissemination in the last forty years has realized cumulatively only 30 percent of India’s total national potential.
• Potential: 12 million Biogas plants of 2 Cu.m
• Installed plants: 3.7 million plants

In terms of quantifiable monetary ('real economic') benefits and costs, the Biogas plants programme resulted in annual monetary saving of Rs 128 million as against the annual cost of Rs 150 million. [Dhanawas experiment of TERI 1983-2002]

This study does not take into account:
- the potential of using BgM

Thus an important bottle-neck in Biogas technology dissemination can be overcome through promoting BgM based sustainable farming technologies.

Need for an Holistic Accounting system

A-Cash Accounting
B-Energy Accounting
C-Environmental Accounting
D-Conservation Accounting
E-Social Accounting
Gandhian economist Dr. J.C. Kumarappa was the first person to proclaim the importance of spent biogas slurry as nutrient rich organic manure.

Need for alternative nutrient management models

- Increasing cost of nitrogenous fertilizers
- Hidden costs of environmental degradation by nitrogenous fertilizers
- Increase in pest attacks when nitrogenous fertilizers are applied to crops and hence increase in chemical pesticide use
- Still there is need to increase the fertility of soil and increase the crop production to feed the growing populations of developing countries

Fertilizer Forecast:

“Nitrogen fertilizer production uses natural gas as a raw material. As well the process requires a lot of heat which may also be supplied by natural gas. With natural gas prices having increased dramatically over the past year, nitrogen costs are expected to increase by 30 percent”

What is BgM?

Biogas Manure (BgM) is a by-product obtained from the biogas plant after the digestion of dung or other biomass for the generation of methane rich gas.

BgM application to soil: advantages

- Supplies essential nutrients
- Enhances water holding capacity
- Enhances soil aeration
- Accelerates root growth
- Inhibits weed seed germination

Different types of BgM

Liquid BgM
- Solid content: 6 percent
- pH value: 8 to 9 (alkaline)
- Nitrogen: 1.8 percent

Semi Dried BgM
- Solid content: 15-20 percent
- pH value: 7 to 9 (neutral to alkaline)

Dry BgM
- Slurry coming out.
- Solid: 20-30 percent
- pH value: 7-8
- Has micro-nutrients
- Less nitrogen
- Loss of nutrients if sun-dried

Best form for use
BgM compared in terms of NPK content with other Organic manures

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Manure</th>
<th>N₂ Percent</th>
<th>P₂O₅ Percent</th>
<th>K₂O Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fresh Cattle Dung</td>
<td>0.3-0.4</td>
<td>0.1-0.2</td>
<td>0.1-0.3</td>
</tr>
<tr>
<td>2.</td>
<td>Farmyard manure</td>
<td>0.4-1.5</td>
<td>0.3-0.9</td>
<td>0.3-1.9</td>
</tr>
<tr>
<td>3.</td>
<td>Compost</td>
<td>0.5-1.5</td>
<td>0.3-0.9</td>
<td>0.8-1.2</td>
</tr>
<tr>
<td>4.</td>
<td>Poultry manure</td>
<td>1.0-1.8</td>
<td>1.4-1.8</td>
<td>0.8-0.9</td>
</tr>
<tr>
<td>5.</td>
<td>Cattle Urine</td>
<td>0.9-1.2</td>
<td>Trace</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>6.</td>
<td>Paddy straw</td>
<td>0.3-0.4</td>
<td>0.8-1.0</td>
<td>0.7-0.9</td>
</tr>
<tr>
<td>7.</td>
<td>Wheat straw</td>
<td>0.5-0.6</td>
<td>0.1-0.2</td>
<td>1.1-1.3</td>
</tr>
<tr>
<td>8.</td>
<td>BgM</td>
<td>1.5-2.5</td>
<td>1.0-1.5</td>
<td>0.8-1.2</td>
</tr>
</tbody>
</table>

Source: Regional Centre for Biogas development IIT, Kharagpur, India

BgM study in Maize: Assam, India

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (m)</th>
<th>Cob weight (g/cob)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>2.10</td>
<td>188</td>
</tr>
<tr>
<td>BgM</td>
<td>2.14</td>
<td>263</td>
</tr>
</tbody>
</table>

Source: AAU Jorhat
**BgM in horticultural crops: Tomato (Lycopersicon esculentum)**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Treatment</th>
<th>Fruit Yield (kg/Plot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>BgM</td>
<td>9.9</td>
</tr>
<tr>
<td>2.</td>
<td>BgM with Urea</td>
<td>8.6</td>
</tr>
<tr>
<td>3.</td>
<td>Control</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Slurry application: 10 t/ha

N fertilizer: 150 kg/ha

Data: Study by Sree Parasakthi College for Women, Courtallam

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**Biogas Slurry in biological nematode control**

- The effect of biogas slurry application on the severity of root-knot nematode, attack on tomato, was tested in the green house with two levels of biogas slurry: 5% and 10% (w/w) added to soil.
- Both the number (3 fruits/plant) and fruit yield (35.2 g/plant) of tomato increased significantly with 10% (w/w) biogas slurry.
- The plants amended with biogas slurry put up more vegetative growth and tended to flower and fruit much earlier than did those of the control.
- The nematode population in the soil decreased thus decreasing the severity of nematode attack.

Source: Management of root-knot nematode in tomato Lycopersicon esculentum, Mill, with biogas slurry. Jothi et al. Department of Nematology, Tamil Nadu Agricultural University, Coimbatore
### Biogas Manure Plant Economics:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Plant Size (Cu.M)</th>
<th>Equivalent Fire wood/day (Kg.)</th>
<th>Amount [Rs]</th>
<th>Bg M/day (kgs) @ 25 percent efficiency of input surry</th>
<th>Manure Cost (Rs)</th>
<th>Total Income from the BgM plant (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1</td>
<td>3.20</td>
<td>6.45</td>
<td>12</td>
<td>3.50</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
<td>6.40</td>
<td>13.00</td>
<td>24</td>
<td>7.25</td>
<td>20</td>
</tr>
<tr>
<td>3.</td>
<td>3</td>
<td>9.65</td>
<td>19.25</td>
<td>36</td>
<td>10.75</td>
<td>30</td>
</tr>
<tr>
<td>4.</td>
<td>4</td>
<td>12.85</td>
<td>25.75</td>
<td>48</td>
<td>14.50</td>
<td>40</td>
</tr>
</tbody>
</table>

### Individual case study:

- **Name of farmer:** Sri. Thangakailasam
- **Village:** Vijayanagari, Kanyakumari district
- **Plant size:** 3 cu.M
- **Duration:** Last 10 years
- **Initial investment:** Rs 10,000
- **Payback period:** 2 years
- **Return of investment:** 50 percent per year [slurry use-as fertilizer taken into account]
- **Indirect benefits:**
  - Clean kitchen
  - No soot and smoke
  - Health savings for household women
**Individual case study:**

Name of farmer: Sri. Gomathinayagam  
Village: Puliangudi, Thirunelveli district  
Livestock owned: 20 cows and one stud bull  
Number of biogas plants: 2  
Model: Deenbandhu plants  
Capacity: 4 cu.M  
Duration: Last 12 years  
Slurry used as manure in: 8 acres of land  
Crops nourished: 250 coconuts, lemon and Calopogonium  
Fresh biogas slurry is let in the irrigation channel  
Farmer’s statement:

“No need for external ingredients to manage the nutrient status of the soil as BgM treated soil has sufficient earthworms – a good indicator of soil fertility”

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**Individual case study: Soil: bio-parameters**

Name of farmer: Sri. Gomathinayagam

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Bacteria</th>
<th>Non-BgM Soil</th>
<th>BgM treated soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bacteria</td>
<td>11,50,000</td>
<td>15,00,000</td>
</tr>
<tr>
<td>2.</td>
<td>Fungi</td>
<td>20,000</td>
<td>70,000</td>
</tr>
</tbody>
</table>

[Data: Soil sample of BgM treated soil collected from the farmer Sri. Gomathinayagam, Village: Puliangudi, Thirunelveli district and analyzed at Parasakthi College, Courtallam, Tamilnadu]
Village study: Idayanvillai, Kanyakumari district

Of the 33 households with Biogas plants 28 households use biogas slurry as manure in a two-cropping system.

The biogas plant size: 2 cu.m
BgM output per day: 24 kg.
Per day BgM production: 672 kg
Money value of per day BgM produced in terms of manure cost: Rs 203
BgM money value Per month per household: Rs 217.50

1 Indian Rupee (Rs) app. = 45-48 US $

Village study: Idayanvillai

Value added products potential

BgM can be used to enrich Vermi compost also. Given the current minimum rate of Rs 2 per kg of Vermi compost, BgM enriched Vermi-compost can be sold at the same rate as well as at a slightly increased rate at Rs 2.50 -3 per kg. The potential for such compost preparation per day at Idayanvillai village of 28 BgM users is Rs 1344 which is Rs 48 (equivalent to app. 1 US $) per person.
Future Possibilities: Oil-borne seeds based Bio-fuel

- Majority of rural households lack cattle dung needed for Biogas production

- Need for cheap and abundantly available feed material for Biogas

- 42 identified and well-used species of oil seeds have the potential of being used as bio-fuel.
- of the tree-borne oil seeds yield 25 percent oil and 70 percent cake which is feed material to the Biogas plant

- no need for monoculture cultivation of trees

Future Possibilities: Oilcake input for Biogas

- Non-edible Oil-cakes studied as feed materials in Biogas:

  - Neem (Azadirachta indica),
  - Pongamia (Pongamia pinnata),
  - Jatropha (Jatropha curcas),
  - Mahua (Madhuca indica) and
  - Sal (Shorea robusta)
Jatropha – Life cycle

- Gas for domestic use
- Slurry as plant nutrient
- Oil Cake
- Oil Extract
- As bio-fuel
Jatropha curcas

- 2500 Plants / hectare
- EXPECTED YIELDS

<table>
<thead>
<tr>
<th>Year after Planting</th>
<th>Expected yield per/ha Rainfed Crop (Kg)</th>
<th>Expected yield per/ha Irrigated Crop (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td>2nd</td>
<td>250</td>
<td>1000</td>
</tr>
<tr>
<td>3rd</td>
<td>1000</td>
<td>2500</td>
</tr>
<tr>
<td>4th</td>
<td>2000</td>
<td>5000</td>
</tr>
<tr>
<td>5th</td>
<td>3000</td>
<td>8000</td>
</tr>
<tr>
<td>6th</td>
<td>4000</td>
<td>12000</td>
</tr>
</tbody>
</table>

Bio-fuel (Neem oil) used in diesel engine for generating electricity at VK-NARDEP Technology Resource Centre, India.
Neem cake based 1 cum Biogas Plant @ VK-NARDEP Technology Resource Centre, India.

Multi-Dimensional Benefits of BgM

- Defense Against Pests
- Maintains Soil Fertility
- Pollution Free
- Quality Food
- Balanced Nutrition
- Wholesome
Thank You

Biogas Manure is the Winner