LOW-COST PLASTIC BIOGAS DIGESTER IN INTEGRATED FARMING SYSTEMS IN VIETNAM

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Why have we worked with low-cost plastic biogas digesters?

• Livestock production in Mekong delta of Vietnam is mainly in smallholders

• Plastic biogas digesters can:
  – Control pollution
  – Produce biogas daily
  – Produce a big amount of effluent daily
• Plastic biogas digester technique

- simple

- easy to adopt

- supporting for the agricultural production systems (interaction & solely play role)
• But:

The number of PBD in the area is very limited

⇒ may have some constraints to limit the development of the technique
OBJECTIVES

- Clarifying the bottleneck of PBD
- Improving the efficiency of this technique
- Producing biogas from manures
- Utilization of effluent
  → the ability of introducing PBD into the small-scale IFS
Introduction

- Low cost plastic biodigesters can play role as a sub-component in integrated farming systems
- More than 30,000 units installed during the past ten years (Khang, 2003)
The number of plastic film biodigesters in year
Methodology

• Carried out the researches at the university
• Interviewed the farmers
• Selected the participant farmers
• Carried out the technical demonstrations
• Monitored gas composition, nitrogen and phosphate concentrations, bacteria in effluent
• Carried out the experiments on using effluent
• Organized Workshop with the farmers and transfer practical technique
Results and discussion
Researches at the university

- The suitable ratio of length and diameter

- Total nitrogen, ammonia nitrogen, pH of the effluent from biodigesters with different length : diameter ratios
Effluent for cassava forage production

- Cassava can be produced as forage for ruminant
- Cassava plant also produces a lush crop of leaves
- The CP content in cassava foliage ranges from 19-23% of DM

- Cassava forage are regarded as a good protein source for animal feed
- The effects of effluent (slurry) from biodigester on foliage and tuber yields and nutritive value of cassava foliage had been investigated
Fresh and dried weight proportions of cassava foliage applied with or without slurry (Khang, 2003)

<table>
<thead>
<tr>
<th>Proportion (%)</th>
<th>Without</th>
<th>With</th>
<th>SEM</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fresh proportion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td>60.45</td>
<td>61.85</td>
<td>0.44</td>
<td>0.05</td>
</tr>
<tr>
<td>Petiole</td>
<td>20.46</td>
<td>20.72</td>
<td>0.19</td>
<td>0.53</td>
</tr>
<tr>
<td>Stem</td>
<td>19.09</td>
<td>17.43</td>
<td>0.52</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Dry proportion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td>60.14</td>
<td>65.53</td>
<td>0.53</td>
<td>0.001</td>
</tr>
<tr>
<td>Petiole</td>
<td>20.13</td>
<td>18.39</td>
<td>0.14</td>
<td>0.001</td>
</tr>
<tr>
<td>Stem</td>
<td>19.75</td>
<td>16.08</td>
<td>0.49</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Introducing PBD into VAC farming system models

• Conversion organic matters
• Increasing productivities
• Generating income
• Contributing the sustainable development of the farming systems
• Improving farm and farmer living conditions
Treatments of pig manure in the villages

- Fish pond: 56%
- Biogas: 40%
- Composting: 2%
- Canal: 2%
Installation and monitoring

• Interviewed with farmers

• **Selected participant farmers:**
  – favorable to apply the technique;
  – dominantly engaged pigs;
  – having ability to diffuse the technique;
  – enthusiastically cooperated with the project;
  – ……

• **Farmers’ excursions (PBD users)**
Introducing PBD… (con’d)

- Demonstration: cost, practices on using and management
- Workshop with farmers
- Training
- Transfer technology of low-cost plastic biogas digester
- Follow up (farmers’ practices and further supports)
Introducing PBD…(con’d)

- 44 PBDs were installed into VAC models
- Farmer’s visits (108 farmers)
- Training on practical technique (49 farmers, 11 extension members)
- 14,000,000 VND credit for farmers
- Costs about 6-700,000 VND (40-50 USD)
# Development of plastic biogas

<table>
<thead>
<tr>
<th>Village</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
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<tbody>
<tr>
<td>T. P. Thanh</td>
<td>8</td>
<td>12</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>Dong Thanh</td>
<td>-</td>
<td>-</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Hoa an</td>
<td>2</td>
<td>11</td>
<td>29</td>
<td>33</td>
</tr>
</tbody>
</table>
## Matrix ranking of the constraints and income

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Labour</th>
<th>Capital</th>
<th>Technology</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit/crops</td>
<td>***</td>
<td>***</td>
<td>****</td>
<td>***</td>
</tr>
<tr>
<td>Rice</td>
<td>***</td>
<td>****</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Fish rearing</td>
<td>**</td>
<td>***</td>
<td>****</td>
<td>******</td>
</tr>
<tr>
<td>Pigs</td>
<td>***</td>
<td>****</td>
<td>***</td>
<td>**</td>
</tr>
<tr>
<td>Biogas</td>
<td>*</td>
<td>***</td>
<td>***</td>
<td>**</td>
</tr>
</tbody>
</table>
Chemical and biological analysis

• **Gas composition:**
  – 65:35 (methane and dioxide)
  – 50-70% methane
  – 30-40% dioxide
  – 5-10% hydrogen
  – 1-2% nitrogen
  – Water vapor 0.3%
  – Hydrogen sulfate (trace)
### Ammonium and phosphate (mg/l)

<table>
<thead>
<tr>
<th>Site</th>
<th>Time</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NH₄-N</td>
<td>428</td>
<td>409</td>
<td>424</td>
<td>430</td>
<td>357</td>
</tr>
<tr>
<td></td>
<td>PO₄-P</td>
<td>116</td>
<td>129</td>
<td>106</td>
<td>158</td>
<td>129</td>
</tr>
<tr>
<td>2</td>
<td>NH₄-N</td>
<td>32</td>
<td>114</td>
<td>75</td>
<td>84</td>
<td>168</td>
</tr>
<tr>
<td></td>
<td>PO₄-P</td>
<td>33</td>
<td>89</td>
<td>47</td>
<td>62</td>
<td>87</td>
</tr>
<tr>
<td>3</td>
<td>NH₄-N</td>
<td>314</td>
<td>275</td>
<td>323</td>
<td>316</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>PO₄-P</td>
<td>153</td>
<td>206</td>
<td>204</td>
<td>236</td>
<td>204</td>
</tr>
<tr>
<td>4</td>
<td>NH₄-N</td>
<td>157</td>
<td>462</td>
<td>484</td>
<td>538</td>
<td>542</td>
</tr>
<tr>
<td></td>
<td>PO₄-P</td>
<td>68</td>
<td>66</td>
<td>65</td>
<td>77</td>
<td>52</td>
</tr>
<tr>
<td>Site</td>
<td>Bacteria</td>
<td>Average number/ml</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm 1</td>
<td>E.coli Salmonella spp.</td>
<td>Affluent: (740 \times 10^2)  Effluent: (10 \times 10^2)  (\text{Affluent: } 1.7 \times 10^2)  Effluent: (0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm 2</td>
<td>E.coli Salmonella spp.</td>
<td>Affluent: (8,200 \times 10^2)  Effluent: (18 \times 10^2)  Affluent: (8.3 \times 10^2)  Effluent: (0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm 3</td>
<td>E.coli Salmonella spp.</td>
<td>Affluent: (700 \times 10^2)  Effluent: (42 \times 10^2)  (\text{Affluent: } 1.7 \times 10^2)  Effluent: (17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm 4</td>
<td>E.coli Salmonella spp.</td>
<td>Affluent: (668 \times 10^2)  Effluent: (92 \times 10^2)  (\text{Affluent: } 11 \times 10^2)  Effluent: (0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Using the effluent as an organic fertilizer

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean yield (kg)</th>
<th>SE +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.34</td>
<td>0.26 ns</td>
</tr>
<tr>
<td>CF</td>
<td>2.18</td>
<td>0.32 *</td>
</tr>
<tr>
<td>EF-3</td>
<td>2.3</td>
<td>0.33 *</td>
</tr>
<tr>
<td>EF-6</td>
<td>2.02</td>
<td>0.45 *</td>
</tr>
</tbody>
</table>

P=0.056, * different significant at 95%
Conclusion

• Plastic biogas digester was accepted by farmers

• Effluent can be used as organic fertilizer source

• Plastic biogas digester can support for the systems

• But there are constraints
The constraints for the dissemination of this technology to small-scale farms

- farmer’s perception
- instability of swine production
- easy broken of fermentation tube
- flooding water effect
- lack of promotion activities of local government or other organisations
- some technical problems
- labour for using effluent
Biogas digesters around the southeast Asia countries

• Thailand
• Laos
• Cambodia
• Malaysia, and China
• Workshop on renewable energy and biogas technology in March of 2002, Ho Chi Minh city, Vietnam
Some pictures of our story!
Setting:
Farmer can install PBD by themselves
Water spinach using effluent
Cassava is as a perennial crop by untilization of effluent