DOCUMENTATION OF DEMONSTRATION PROJECT EXPERIENCES

A Demonstration Project on Generation of Bio-gas Using Market Waste in Sri Jayawardenapura Kotte Municipal Council Area (SJKMC), Sri Lanka

Sri Jayawardenapura Kotte Municipal Council, Sri Lanka
UNDP / UN- Habitat Sustainable Cities Programme (SCP)
Sustainable Core Area Project (SCCP)

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A Demonstration Project on Generation of Bio-gas Using Market Waste in Sri Jayawardenapura Kotte Municipal Council Area (SJKMC), Sri Lanka

May 2002

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### Some Basic Facts about Sri Jayawardenapura Kotte Municipal Council

<table>
<thead>
<tr>
<th>Area</th>
<th>Municipal Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of Municipal Area</td>
<td>1704 Hectares (17.04 sq.km.)</td>
</tr>
<tr>
<td>No. of Municipal Districts</td>
<td>01</td>
</tr>
<tr>
<td>No. of Municipal Wards</td>
<td>11</td>
</tr>
<tr>
<td>No. of Elected members</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Population (2001)</td>
<td>115,826</td>
</tr>
<tr>
<td>Floating Population (2001)</td>
<td>50,000 (Estimate)</td>
</tr>
<tr>
<td>Average Population Density (2001)</td>
<td>68 p/ha</td>
</tr>
<tr>
<td>Annual Population Growth Rate (1995)</td>
<td>1.20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Housing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent Dwelling Units</td>
<td>19600 – 80%</td>
</tr>
<tr>
<td>Slums / Old Settlements</td>
<td>-</td>
</tr>
<tr>
<td>Shanties</td>
<td>4899 - 20%</td>
</tr>
</tbody>
</table>
**Total No. of Units**      | 24499 – 100%      |

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Network</td>
<td>90 k.m</td>
</tr>
<tr>
<td>Sewerage Network</td>
<td>No pipe sewerage system,</td>
</tr>
<tr>
<td>Garbage Generation</td>
<td>130 tons p/d</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manpower</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadre of Employees</td>
<td>1,454</td>
</tr>
<tr>
<td>Number in place (1999)</td>
<td>884</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Budget for 2000 (Amounts in Rupees)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Income</td>
<td>609,487,200</td>
</tr>
<tr>
<td>Total Expenditure</td>
<td>609,431,800</td>
</tr>
<tr>
<td>Surplus</td>
<td>57,400</td>
</tr>
</tbody>
</table>
1.0 BRIEF DESCRIPTION OF THE DEMONSTRATION PROJECT

The Sri Jayawardenapura Kotte Municipal Council (SJKMC) area is located on the eastern boundary of Colombo City about seven kilometers away from Colombo city centre. The SJKMC was declared by the government of Sri Lanka as its administrative capital in the 1980s while Colombo city maintains its status of being the commercial and financial capital of Sri Lanka.

The SJKMC is relatively a small municipality, which covers a land area of about 16.7 sq.km. and having a population of about 115,826 persons (as per population census 2001) within its authority area.

It is primarily a residential city of middle income working population of Colombo. The city is also famous for its heritage value being one of the ancient kingdoms of Sri Lanka. The SJKMC is gifted with many environmental resources such as lakes, canals and wetlands of a rich bio-diversity.

However, like many other Sri Lankan cities, the SJKMC too faces problems of poor infrastructure facilities to cater to the demand of its citizens. The city does not have a sewer network, its storm water drainage system too does not cover the entire city while solid waste disposal has also become a virtual threat to human health and environment due to lack of a proper disposal mechanism. Open dumping of solid waste into low lying marshy areas has already created many problems such as loss of bio-diversity, disrupting the drainage system etc.

The SJKMC has become one of the three municipalities of the UNDP / UN-Habitat – Sustainable Cities Programme (SCP) which has been in operation in Sri Lanka since 1998. The city has gone through the SCP Process of identifying of the city's stakeholders, identification of environmental issues, formation of issue specific working groups, preparation of City Environmental Profile as well as conducting a Sanitation Consultation. The SCP City Consultation Process has generated enthusiasm among the local politicians, the municipal officials as well as the city's stakeholders to look at the city's problems and opportunities in a more participatory manner where consultation and consensus being the main approach to problem solving in the city.

Among a number of priority development issues, SWM has been identified as the most prominent and as requiring the most amount of attention by the stakeholder groups.

(Among a number of priority development issues, solid waste management has been identified prominent as the city's stakeholder groups raised their concern over the current status of the problem of poor solid waste management.)

The Local Partner Institution for SCP an urban based NGO - SEVANATHA has played an important role in the SCP Process by bringing the city's stakeholders together to develop a strategy for solid waste management for the city. The participatory approach followed by the project working group established at the municipality had paid greater emphasis on citizen awareness raising and reducing the volume of waste by way of promoting household level waste minimization methods. Introducing home composting bins, experimenting with the use of market waste for generating bio-gas, environmental awareness to prevent dumping of
garbage into environmentally sensitive areas, were some of the alternatives tried out by the SJKMC.

Among these, the use of market waste to generate bio-gas became one of the significant demonstration projects that attracted a large audience of city's stakeholders. The bio-gas unit constructed was the first ever experiment by an urban local authority for using the market waste for producing bio-gas. The bio-gas unit was constructed at a children orphanage premises within the municipality where about 300 children were housed. This present report highlights the experience of this demonstration project.

1.1 Objective of the Project

The primary objective of the demonstration project was to experiment the viability of using market waste as a resource for producing bio-gas, which eventually would help in reducing the volume of market waste coming into the municipal waste stream so that the municipality would benefit by way of saving its resources while generating energy from waste thus a saving for the orphanage.

1.2 Scope of the Project

Since it was an experiment project, only a single bio-gas unit was constructed to absorb approx. eight (08) Mt. tones of market waste. If the experiment becomes beneficial the project would be replicated within the city.

1.3 Project Period : April 2001 to October 2001

1.4 The Project Approach

Based on the SCP principles, the demonstration project followed the participatory approach from the initial stage of the project through its implementation.

1.5 Key Steps of the Project

Step 1 : Identification of key stakeholders
Step 2 : Forming the project working group at the municipality
Step 3 : Meetings and consultations among stakeholders
Step 4 : Consultation on alternative solutions to solid waste problem
Step 5 : Developing the demonstration project idea and action plan
Step 6 : Carrying out the project activities
Step 7 : Monitoring of project activities

Step 8 : Experience sharing and dissemination of project findings

2.0 PARTNERS ENGAGED IN THE PROJECT

A number of partners were engaged in the demonstration project who contributed their expertise at different stages of the project implementation. The following table presents a summary of partner involvement.

<table>
<thead>
<tr>
<th>Partner</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Sri Jayawardenapura Kotte Municipal Council</strong></td>
<td>? Supported the decision of the project working group to establish a bio-gas unit</td>
</tr>
<tr>
<td>(Mayor, Municipal Councilors, Municipal Commissioner, Deputy</td>
<td>? Provided technical staff</td>
</tr>
<tr>
<td>Municipal Commissioner, Municipal Engineer, Medical Officer of Health,</td>
<td>? Provided unskilled workers</td>
</tr>
<tr>
<td>Development Assistant and MC field staff)</td>
<td>? Provided vehicles &amp; equipments support</td>
</tr>
<tr>
<td></td>
<td>? Participated at regular meetings of the project working group</td>
</tr>
<tr>
<td><strong>2.2 Sri Vajira Children's Home</strong></td>
<td>? Agreed with the project idea</td>
</tr>
<tr>
<td></td>
<td>? Agreed to provide the required land space for the bio gas unit within its premises</td>
</tr>
<tr>
<td></td>
<td>? Provided unskilled labour during the construction</td>
</tr>
<tr>
<td></td>
<td>? Provided man power to look after completion</td>
</tr>
<tr>
<td></td>
<td>? Utilized the bio gas for cooking purpose and enjoyed the benefits of the project for about six months</td>
</tr>
<tr>
<td>**2.3 The Intermediate Technology Development Group (ITDG) County</td>
<td>? Provided technical know how and design for construction of bio gas unit to SEVANATHA</td>
</tr>
<tr>
<td>Office (an international NGO)</td>
<td>? Participated in construction supervision</td>
</tr>
<tr>
<td></td>
<td>? Provided guidance on operational aspects of the unit</td>
</tr>
<tr>
<td><strong>2.4 SCP Project Working Group (WG)</strong></td>
<td>? Discussed the solid waste management issues and formulated alternative solutions</td>
</tr>
<tr>
<td>(municipal staff, community members, politicians, local NGO)</td>
<td>? Developed the idea of setting up a bio gas unit</td>
</tr>
<tr>
<td></td>
<td>? Carried out regular meetings</td>
</tr>
<tr>
<td></td>
<td>? Managed to convince the mayor and the management of the children's home on the project</td>
</tr>
</tbody>
</table>
### Partner Responsibilities

#### 2.5 SEVANATHA – Local Partner Institution

- Worked very closely with the municipal staff (SCP WG member)
- Put forward the idea of constructing the bio-gas unit
- Engaged in carrying out field data collection on market waste and identification of places for bio-gas unit
- Collected information on external support institutions
- Worked out an action plan with the project working group to construct the bio-gas unit
- Carried out the construction supervision of the bio-gas unit with the municipality
- Participated in awareness raising among the stakeholders on achievements
- Monitored the performance of the bio-gas unit

#### 2.6 UN-Habitat Sustainable Cities Programme – SCCP Project Working Group

- Introduced the SCP Process
- Established SCCP Project Working Group at SJKMC
- Project upscaling & dissemination

### 3.0 PROJECT IMPLEMENTATION PROCESS

Project implementation process can be summarized into four main tasks carried out by the working group and key project partners.

#### 3.1 The Task One : Project Preparation

**i.** A project team consisting of SEVANATHA and SJKMC visited the municipal markets and commercial centres of the city and estimated the volume of market waste generated at each points. Through the survey it was observed about 10% - 12% of the total volume of the city's solid waste is being generated by these market places.

**ii.** Subsequently another field survey was carried out to identify the potential locations where bio gas units can be constructed. The following criteria was used for this purpose.

- The land should be owned by the municipality or government.
- The minimum size of the land should be above 25 sq.m. and be a high land with easy motorable access.
- Possibility of using the bio gas within the location.
- The beneficiaries must show the commitment for its maintenance.
- Approval for the location by the project working group.
The project team has identified 20 possible locations. Among them Sri Vajira Children's was identified as being most deserving site by the working group (among others about 10 other preferable sites were chosen for future consideration).

Subsequently, the SEVANATHA local partner sought the technical support of the ITDG office to construct the bio gas unit at the above location.

3.2 Task Two : Construction of the Bio-gas Unit

i. As requested by SEVANATHA, the technical design of bio-gas units was provided by the ITDG office for the purpose.

ii. The unit was of small in size having 04 cu.m. capacity.

iii. The design was based on the Chinese method of bio gas generation.

iv. The land lot was demarcated at the site of the Children's Home for the purpose.

v. The construction work consisted two sections, the chamber where the waste was going to be stored and the gas container system where the bio gas will be stored.

vi. The chamber was constructed below the ground level by a trained mason.

3.3 Task Three : Filling of the Bio-gas Unit Using the Market Waste

i. While the construction work at the bio-gas unit was progressing an awareness campaign was carried out for the businessmen at the fruit and vegetable market at Nugegoda (Janathapola Market) for separation of waste into bio-degradable and non-biodegradable.

ii. Awareness meetings were carried out for the field staff of the municipality (overseers of the waste management section, the waste collectors and tractor driver and helpers) about the project and need for separation of waste.

iii. Subsequently, the overseers of the area was requested to prepare a time table to collect the biodegradable waste from the market and transport it to the bio-gas site.

iv. It took 08 working days to fill the bio-gas unit with market waste. It was estimated that about 08 Mt. tones of market waste was stored in the chamber.
3.4 Task Four: Operation of the Bio-gas Unit

i. After filling of the chamber with market waste some amount of cow-dung and urea manure was added to the waste to initiate the waste degradation process. Subsequently, the mouth of the chamber was sealed and the gas storing barrels were connected to the chamber.

ii. After about two weeks time, it was observed that the gas generation has commenced. Due to low pressure at the initial stage of gas generation, it was required to empty the storage barrels through the valve system.

iii. Subsequently, when the decomposition process was at a high stage, sufficient pressure was generated at the gas storage barrels. Thus after 25 days of closing the bio-gas chamber, sufficient bio-gas was generated with adequate pressure to be used for cooking purpose. The gas so generated at the bio-gas unit was used for about six months period (from May 2001 to October 2001) for cooking purpose at the children's home kitchen.

iv. After about six months, the pressure of the gas dropped to a level where it was not able to use. This signaled the need for emptying the chamber and refilling it with fresh garbage and running the process again.

v. Before, refilling, the decomposed garbage was required to be taken out of the chamber which according to the ITDG, could be used for gardening purposes (as soil conditioner fertilizer).

4.0 Achievements of the Project

i. The above bio-gas unit was the first ever successful experiment carried out in an urban area using market waste for generating energy in Sri Lanka.

ii. The demonstration project was implemented by a working group established under the SCP project at Sri Jayawardenapura Kotte Municipal Council.

iii. It has demonstrated the viability of using the market waste to generate bio-gas.

iv. The bio-gas generated by the unit was used for the benefit of orphanage children where by the management of the children's home was said to have saved about Rupees 30,000 during the above six months period.

v. The Kotte municipality was able to train some of its field staff in construction and operation of the bio-gas unit.

vi. Knowledge about waste separation & energy production from biodegradable waste was created among the children at the orphanage.
4.1 **Sustainability of the Project**

i. The Mayor of Kotte Municipal Council has shown his interest in the project and advised the project working group to initiate construction of ten (10) such units within the municipal area.

ii. The gas generated by the bio-gas unit was sufficient to be used for large scale business and helped to save a considerable amount of energy.

iii. The construction of bio-gas unit was found not too complicated and hence sufficient man power can be trained with little effort and financial support.

iv. The raw material (market waste) required for the bio-gas unit is freely available throughout the year.

v. The cost of the demonstration unit was about Rupees 87624 (US $ 973) which could be further reduced when more units are constructed by using the manpower of the municipality.

vi. Above all, there will be a demand from public and private sector for the use of bio-gas generated through this means due to low cost of bio-gas in the long run.

4.2 **Replicability of the Project**

i. The successful results achieved by the demo project has won the confidence of the Mayor, the Councilors and the senior municipal officials. They have already given their consent to construct more units within their municipal area.

ii. The idea of construction of two bio-gas unit at one location would help continuation of the bio-gas supply since the market waste is readily available as the main raw material for the process.

iii. The municipality would be able to find sponsorship for a successful upscaling of the project since it can be marketed in the area.

5.0 **LESSONS LEARNED**

i. On the whole lessons learned from the demonstration project were positive as the partnership approach adopted for urban waste management involving the municipality, traders, the NGOs, the ITDG and a beneficiary group could be replicated elsewhere. This was quite a new practice when compared to hither to practiced municipality dominated processes which never paid attention to resource recovery of municipal waste and responsibility sharing.

ii. Change of attitudes of the municipal officials towards involving the city's stakeholders to share the responsibilities of the municipality in its service delivery process is perhaps being the most important lesson learned in this demonstration project.
iii. The demo project has proved that it would be possible to start small scale local area based alternatives to solid waste management problem as against conventional municipal wide collection and dumping of solid waste.

iv. Finally, the awareness raised among a large section of the city population about looking at the solid waste management issues from different angles i.e. waste minimization resource recovery of waste, area based approaches for SWM can be listed recovered as an important lesson learned through this demonstration project.

6.0 ASPECTS OF COST BENEFITS OF THE PROJECT

Since the construction of a bio-gas unit using market waste was only an experiment, the working group did not pay much attention to carry out a cost benefit analysis of the project. However, when it become successful it was felt important to record the costs and benefits of the project in order to guide future replication of the idea. This may not be considered a real cost benefit analysis since all the aspects of a conventional cost benefit analysis have not being included in this exercise due to lack of data for the purpose.

6.1 The Cost Aspects

i. Costs involved in awareness raising among field staff of the municipality.

ii. Costs involved in awareness raising among the traders of the vegetable / fruit market.

iii. Costs involved in the staff who were directly involved in the project i.e. project manager of NGO, project officers and project staff of the municipality.

iv. Cost of the land lot used for the construction of bio-gas unit.

v. Costs involved in construction of the bio-gas unit.

? Site clearance
? Ground excavation
? Fabrication of the underground part of the chamber
? Completion of the chamber (plastering, final finish)
? Construction of bio-gas storage tanks (costs of barrels, valves, chamber etc.)
? Labour costs (skilled, unskilled)
? Supervision costs (payment for technical supervision during construction)
? Transport cost of sorted out market waste to the site
? Filling of the bio-gas chamber with waste
? Labour charges for handling the waste
? Cost of other ingredients (urea manure and cow dung etc.)
? Supervision cost of the bio-gas unit after filling it with waste (this involved twice a week inspection for recording the performance of the unit)
? Costs Involved in Sealing of any Leakage during the gas-extraction period (this usually happens in the process which require some costs)
? After above six months, when the gas generation was over, removal cost of sludge of the chamber
6.2 Aspects of Benefits and Target Beneficiaries

i. Costs savings involved in reduced distance of transporting the waste to the municipality

ii. Generation of bio-gas using market waste (i.e. 08 Mt. tones of market waste has generated an amount of gas worth Rupees 30,000 (US$ 333). The possibility of refilling and continued usage of same bio-gas chamber for a long term (say 10 years) would definitely generate a surplus value for the investment in constructing the bio gas unit.

iii. Long term benefit of cost savings as against the practices of expensive solid waste management alternatives by the municipality.

iv. Change of attitudes of the municipal officials and the citizen towards resource recovery of solid waste rather than looking at solid waste as something to be thrown out of their premises.

v. Cost saving of the use of bio-gas as against LP gas.

6.3 Direct Costs Involved in Construction and Operation of the Bio-gas Unit at Children’s Orphanage at Kotte

<table>
<thead>
<tr>
<th>Item</th>
<th>Rupees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Material cost</td>
<td>39,024</td>
</tr>
<tr>
<td>(bricks, sand, cement, metal steel, lime, pudlow cement, binding wires, anti corrosive, rafters, planks, GI pipes, coir strings etc.)</td>
<td></td>
</tr>
<tr>
<td>2. Labour Charges (skilled &amp; unskilled)</td>
<td>32,000</td>
</tr>
<tr>
<td>Welding charges</td>
<td>2,500</td>
</tr>
<tr>
<td>3. Basic equipments</td>
<td>4,900</td>
</tr>
<tr>
<td>4. Earth filling and site preparation</td>
<td>3,200</td>
</tr>
<tr>
<td>5. Other expenses (miscellaneous)</td>
<td>6,000</td>
</tr>
<tr>
<td>Total</td>
<td>87,624</td>
</tr>
</tbody>
</table>

6.4 Direct Benefits to the Orphanage

i. Use of bio-gas for cooking purpose form May 2001 to end of October 2001 at the children's orphanage.

ii. Savings due to non-purchase of LP Gas purchase for the above period said to be Rupees 30,000
7.0 CONCLUSIONS

i. It was realized by the project working group that two bio-gas chambers should be constructed at a same premises in order to make it cost effective and to ensure continuity of the production of bio-gas.

ii. This means when two chambers are constructed at one place the continuity of usage can be assured by making one chamber ready for use when the other is emptied.

iii. However, this involves a large sums of money (i.e. about Rupees 150,000 – US$ 1660) which could only be supported by the municipality or by a donor agency.

iv. When many number of bio-gas units can be built at different parts of the city after identification of users, it can really help reducing the volume of market waste otherwise need to be dumped away without making any use. This way, the municipality can be benefited by reducing the costs involved in transportation and disposal of market waste for which suitable dumping sites has become a problem even at present time.

v. However a proper cost benefit evaluation of different scenarios would help in taking a rational decision for upscaling this practices. Through the experiences of the current demo project, it can only be said that this can be considered as one of the beneficial alternatives to tackle the city's solid waste management problems involving the city's stakeholders.