Title: Technology Assessment for Sustainable Sanitation Services in Low-Income Communities.

Author
Garrick E. Louis, and Tisan Ahmad
Department of Systems and Information Engineering
P.O. Box 400747
151 Engineer's Way
Olsson Hall, Room 103
Charlottesville, VA 22904

Abstract

The goal of this paper is to present an objective method for selecting appropriate sanitation service options for low income communities. This goal will be achieved through the objectives of; (i) developing an exhaustive list of MSS technologies, (ii) classifying this list into MSS options, and (iii) ranking these options so they may be mapped into a profile of host communities.

In the past twenty years, many developmental agencies focused intense attention on the water and sanitation sector in an attempt to bridge the gaps in service in low income communities. Although considerable progress has been made, there is still no systematic method for helping a select an appropriate MSS option to implement.

This paper adds to Louis' method to help communities make informed decisions about which of the many MSS options to implement (Louis, 2002). There are two complementary components to this approach: the assessment of the MSS options and the assessment of the community. The assessment of the MSS options will be presented in this paper and the assessment of community which receives these service options, will be discussed briefly. Finally, the method as a whole is then examined and illustrated using a case study.

Keywords: classification, low-income, sanitation, service, selection, community, appropriate, technology

1. Introduction

During the last two decades a concerted effort has been made by many donor organizations to bridge the gap between supply and demand of sanitation services in low-income communities. Although considerable progress has been made, much remains to be done. The 1980s saw the advent of the Water and Sanitation decade (1981-1990) and the 1990s led to a new way of thinking, a community-based approach to the provision of municipal services. However, there is still no systematic approach for helping a community decide which MSS option to implement.

Thus, a first step towards improving living conditions in low-income communities is to address the need for basic water supply and sanitation. This need can be broken down into the three municipal services: drinking water supply (DWS), wastewater and sewage treatment (WWS), and municipal solid waste treatment (MSW).

This paper adds to Louis' framework for helping a community make informed decisions about which of the many MSS options to implement (Louis, 2002). The first part of this approach, the development and classification of service options, is presented in this paper. The second part is the assessment of the community, which is discussed briefly (see Bouabid, 2004).

Finally, a case study will bring together these two components of this framework to show how it can be implemented for a low-income community.

2. Background

In the past, the predominant way of providing development aid involved a top-down approach where the more economically developed countries would provide solutions to poorer countries. Aid was given at a national and regional level and not as frequently at the village level. Experts in all fields spread throughout the world and sought to implant their knowledge. However, this top-down approach was a flawed methodology from the very beginning. A development agency would come into a low-income community and provide a technical solution to the problem. Often this solution did not fit the profile of the community and made the community dependent on external aid in the form of spare parts and technical knowledge. Furthermore, by offering this technical solution, the people did not feel a sense of ownership of the process. The project would work while the donor agency was in the country, however, it failed shortly afterwards (Fukuda et al., 2002).

After the Water and Sanitation decade ended in 1990, the development sector learned valuable lessons and ways to improvement for future initiatives. They quickly became aware of two things: the top-down approach failed to provide adequate service and that in order to be sustainable, the community would have to play a larger role in the process (IRC, 2004). The growing sentiment in the development sector was that these communities themselves should choose the type of service and the service level that they wanted and were willing to pay for.

The idea of community involvement at all stages of the development process came to the fore at the New Delhi Conference in September of 1990. Representatives from some 115 countries met in New Delhi, India and adopted the "New Delhi statement" which recognized that international donors and national governments could not achieve the goals of universal coverage without, among other things, community management and ownership of water supply systems (UNDP, 2004). This marked the first time at a global water conference that community management was endorsed as a guiding principle. Since this conference, most, if not all, of the development agencies have adopted the idea of community involvement into their methodologies for selecting sanitation services.

3. Methodology

Although there are methods for helping a community decide on municipal sanitation options, there is no systematic framework for determining the feasible options given a profile of a community. The following chapter gives an overview of the method developed by Louis that quantifies this MSS selection process in low-income communities. It also presents a technique for developing and classifying the many service options for DWS, WWS, and MSW.

3.1. Overview

Figure 3-1 shows the components of this classification system. There are two main parts to this framework: the assessment of the service options and the assessment of the community.

Figure 3-1: Components of the Classification System

This paper addresses the classification of the technologies and service options. The second part of the classification system will be addressed briefly (see Section 3.5). When the two parts of the classification scheme are brought together, this framework can be applied to any low-income community. A case study of Bacoor, Philippines is given in the Application and Results section to illustrate how the classification system can be used for determining a feasible set of service options for municipal solid waste.

The assessment and classification of the municipal sanitation service options can be achieved through the following objectives.

Objective 1: Compile a list of technologies for the three municipal sanitation services.
Objective 2: Group the MSS technologies into unit operations.
Objective 3: Develop a list of all the possible service options using the technologies in objective 1.
Objective 4: Assess the technologies based on four criteria: cost, energy, technical and institutional requirements.
Objective 5: Formulate the option score for each service option.
Objective 6: Classify each service option on a 5-point scale that maps into a comparable ranking of host communities.

Figure 3-2: Flowchart Mapping Objectives to Options Classification

Figure 3-2 gives a graphical representation of how the objectives lead to the classification of MSS options. First, a comprehensive list of technologies for DWS, WSS, and MSW services was complied from literature. In addition, information was gathered in ten categories for each individual technology. These categories are: (i) brief description of technology, (ii) components, (iii) graphic, (iv) cost, (v) operation and maintenance, (vi) technical knowledge, (vii) environmental considerations, (viii) cultural factors, (ix) miscellaneous, and (x) sources. Next, the technologies were grouped by unit operations, e.g. (source procurement, treatment, storage, and distribution). The service options were developed by iterating through these different unit operations across a MSS. At the same time, the technologies were scored based on the four criteria of Cost, Energy, Technical, and Institutional requirements. Next, the technology scores were brought together with the service option to calculate an option score. Finally, the options were classified into as appropriate for one of five ranked stages of community development.

Stage 1 – High entropy condition
Stage 2 – Pre-community
Stage 3 – Community-based
Stage 4 – Centralized
Stage 5 – Diversified (decentralized)

In the assessment of service options, the development stages represent the level of support needed to implement and sustain a service option. The following development stage descriptions are from (Louis, 2004).

> Stage 1 represents the full entropy condition. This occurs in informal settlements like squatter camps, refugee camps, and shanty towns. There is a high rate of transience in temporary housing units, no defined neighborhoods or communities, and no formal community-based agent for providing MSS.
>
> Stage 2 represents the emergence of fixed housing units, long-term residency, and collective demand for, and evaluation of MSS services by collections of these housing units. This block-level organization also occurs in informal settlements, and in government-sponsored low-income housing projects. In these cases there is a mixture of informal MSS and block-level service by a government agent.
>
> Stage 3 represents the organization of multiple blocks of housing units into a community with common interest in and demand for improved MSS. Fixed housing units with long-term tenants are common and public services may be delivered by an

identifiable, responsive government agent. The community may share in managing the service and its delivery to their incorporated blocks. Formal MSS infrastructure is usually present at this stage.

Stage 4 represents the extension of MSS infrastructure to multiple communities from a centralized service facility. Fixed housing units with long-term tenancy is the norm. An accountable, responsive agent is active in providing the service, which is financed to some degree by the participating communities through direct user fee or indirect taxes.

Stage 5 represents a diversified service delivery system in which the central service provider is complemented by community-based and/or individual systems. These low entropy systems are financed by fixed residence users, operate with surplus capacity of the service, and receive community participation in demand-side management options such as service conservation and recycling. (Louis, 2004)

Once the second part of the framework (community assessment) is completed and a community is profiled (Bouabid, 2004), the number of feasible service options can be brought down significantly. Only the service options at the same level as the community or lower are considered appropriate. An example of this is if the community is at stage 2 for WSS, then the feasible options would be the service options at stage 2 or stage 1 for WSS. Hence, if there are a total of ten possible service options for WSS and a total of four of them are at stage 2 and 1, the number of possible options for WSS is four and six options have been eliminated. The next step in the process is to go back to the community with the list of feasible options and let them decide which of the three options to pursue. This will involve drawing out the preferences of the community. Since the list of options takes into account the profile of the community with respect to the service, it will be an effective planning tool for both the donor organizations and the host community.

3.2. Assessing the Technologies

Four criteria were examined for each of the technologies: Cost, Energy, Technical, and Institutional factors. Each of these criteria can be viewed as a requirement for the technology.

Each technology was evaluated against four criteria: Cost, Energy, Technical, and Institutional factors. Each of these criteria can be viewed as a requirement for the technology. The criteria are summarized in Table 3-1 which shows the mapping of the criteria to the various levels.

Table 3-1: Criteria mapping to levels

As one can see from the table above, Level 1 corresponds to a low requirement level, Level 2 to a medium or moderate level and Level 3 to a high level. The next step in the assessment of the MSS technologies is to determine the level of the each of the technologies with respect to the criteria. This is done by applying the criteria to each of the technologies. Background research was completed for each of the technologies and from this aid, a score of 1, 5 or 10 was assigned for Level 1, Level 2, and Level 3, respectively. Next, each of the technologies was assessed based on the above four criteria. Finally, a normalized score was computed. For example, Table 3-2 shows the how the technology score was computed for Municipal Solid Waste.

Table 3-2: MSW Technology Score

3.3. Development of Options

The technologies that are appropriate for municipal solid waste are provided in Table 3-3. There are a total of 16 technologies (excluding 'None') in this list and they are grouped into the four unit operations of storage, transfer, disposal, and recovery. With these sub categories in place, we can develop a list of the service options for the provision of MSW within a community.

Table 3-3: MSW provision

Table 3-4 shows a subset of all the service options that are appropriate for municipal solid waste. There are 19 options shown in this list of the total 137 options.

Table 3-4: MSW options subset

There are total of four unit operations but an option may have two disposal methods and/or two recovery methods. An example is option 13 that has two disposal methods. A communal bin is first used to store the waste which is taken to a controlled dump where the waste is open burned. There can also be two recovery methods. For instance, option 19 shows that the waste is first stored in a communal bin, and then goes to an open dump, where some of the materials are recycled and the other materials are composted.

3.4. Option Scoring and Development Stage

The next step in the analysis was to apply the normalized scores to each of the options for the three municipal sanitation services.

The option score is calculated by adding two terms, the summation of the technology scores across all unit operations and a multiplicative term and dividing their sum by the maximum potential of the option:

$$\text{Option Score} = \frac{\sum_{i=1}^{N} x_i + w\prod_{i=1}^{N} x_i}{N + w}$$

Equation 1: Option Score

where x_i = technology score for unit operation, N = total number of unit operations, and w = weight for multiplicative term.

The summation of the x_is simply takes the technology score and adds it up across the unit operations. The second term in the numerator is the multiplicative term (Clemen, 1996). This multiplicative function takes into account the number of unit operations that are addressed and rewards options that have all of the unit operations. Conversely, it penalizes options that have one or more of the operations missing because when this occurs, this multiplicative function will go to 0 (Clemen, 1996). This is the case with option 1 as it has only two of the total five unit operations. Finally, the summation of the two terms is divided by the quantity N + w. This is the maximum potential amount that the option could score. If each technology has a score of 1, then the first term would simply equal N and the second term would equal w.

The next step in this classification method is to assign a stage of development to an option. This is straightforward as we have already calculated a score for the option. The following table shows the mapping of the option score to the stage of development.

Table 3-5: Mapping of Option Score to Development Stage

The same scoring system and weighting of 0.1 was employed for WSS. There are three unit operations and so there the multiplicative term is the product of these terms. Finally, the MSW subset of options is shown below.

Table 3-6: MSW Option Scoring

MSW has four unit operations: storage, transfer, disposal, and recovery. However, there can be two disposal processes and two recovery processes. Thus, when the option score is computed, the maximum number of the two columns is used because this is a conservative estimate of the two processes. This number becomes column C3 for disposal and column D3 for recovery. The same process for calculating the option score is used, but with columns C3 and D3. This will bias the final option score by rating it to its highest level thereby reducing the likelihood that a community with a low technology management level will select the option inappropriately.

Now that the classification and ranking of the technologies is complete, we can take the community's technology management level with respect to the municipal sanitation service and match them up.

3.5. Classification of Community

The second part of this method is the classification of the community. The community must be assessed against criteria that measure its capacity to manage a MSS system sustainably. Communities are then classified into one of five stages of development. The community assessment that is presented below has been adapted from Ali Bouabid's master's thesis, "Requirement Analysis for Sustainable Sanitation Services in Low Income Countries." Please see this source for a more complete description.

A community's ability to provide a municipal sanitation service can be assessed by eight capacity factors: Institutional, Human Resource, Technical, Economical, Energy, Environmental, Social and Cultural, and Service. Each community's capacity to sustain a MSS is then evaluated by these eight factors with respect to one of the three sanitation services. Therefore, it is possible for a community to have three different development stage numbers for drinking water supply, wastewater and sewage treatment, and municipal solid waste. For example, a sample community may be at a Stage 3 with respect to drinking water supply, Stage 1 for wastewater and sewage treatment, and Stage 2 for municipal solid waste. This development stage number can be interpreted as a communities' ability to provide a certain sanitation service.

4. Application and Results

The community that is used to illustrate how this framework operates is called Bacoor, located outside of Manila, Philippines.

The deficient municipal sanitation service of the town of Bacoor was municipal solid waste service. Bacoor has a very large resident population and the demand for MSW service greatly exceeds the capacity of the town to deal with it (Magpili, 2003). Thus, an analysis of this community's capacity for MSW service was completed using the eight capacity factors. The assessment of the community was performed by Dr. Luna Magpili (Magpili, 2004). A summary of the assessment is given in Table 4-1.

Table 4-1: Capacity Score Summary

Bouabid uses a minimum rule for determining the stage of development of the community (Bouabid, 2004). As the table above shows, the lowest capacity score is 10, given by both environmental and social and cultural factors. Next, we use Table 4-2 to place the community into a development stage.

Table 4-2: Mapping of Capacity Score to Development Assignment

Since the lowest capacity score is 10 which falls within the first development stage, Bacoor is assigned to Stage 1 with respect to the MSW service. Now that the community has been assessed and given a stage of development of 1, the next step in this framework is to match up the corresponding Stage 1 MSW service options.

Table 4-3: Feasible MSW service options for Bacoor, Philippines

The above table shows 9 of the 47 feasible MSW service options for Bacoor, Philippines a large decrease from the original number of 137 options for the provision of MSW service to this community. Ninety options have been eliminated which is over a 65% reduction. Keeping in line with the idea that a community must be involved in all aspects of the decision making process for municipal sanitation service projects, the next step is to have the residents of Bacoor decide which service option they would like to implement.

5. Conclusions

This new approach for selecting municipal sanitation service options in low-income communities has three significant benefits to society. First, it will help the donor organizations gain a better idea of which projects will work given a profile of a community. Second, this approach will more effectively manage the funding process for related projects and therefore lead to millions of dollars in cost savings. Third, it will provide a list of feasible MSS options to the community.

First, development agencies do not have any way of helping a community to decide what option or options will work for their situation. The process is very much like a gamble as the agency performs a cursory analysis of a community and then subjectively decides which options they believe will work. The process is not scientific in nature, but if the approach presented in this paper is adopted, the donor agency will be able to quantify the assessment of a community and thus have a much better idea of which service options are feasible.

Secondly, an agency will be able to manage its funds much more effectively once the feasible set of service options is developed. Today, one of the major criteria for securing a loan in the development sector is the ability to payback the loan. Other factors such as Social, Environmental, and Institutional requirements are not as important criteria in the process. If this new framework is used, the agency will be able to perform a structured analysis of the community's capacity for a municipal sanitation service, create a list of feasible service options, and then evaluate the host community's proposal for funds.

This tool could also potentially save donor organizations millions of dollars a year. It could be used as a high level tool for decision makers. By bringing down the number of feasible service options to a much more manageable set (see Section 4), it will enable the organizations to evaluate development loan applications in a more effective manner. A team could be sent over to each location and perform the structured analysis of the community and thereby determine whether the proposed MSS options will work given their community profile. This would save millions of dollars a year in wasted funding. Approximately $2.907 billion was spent for water and sanitation projects by OECD countries in 1996 and this amount looks to increase in the future (WHO, 2001). If this classification system can save just a fraction of these funds, it will save millions of dollars a year.

Lastly, this approach will improve upon the current method for sanitation services by determining options that have a better chance of success for a given community. It will serve those who need the most help, the people at the community level.

6. References

Bouabid, M. Ali. "Requirement Analysis for Sustainable Sanitation Services in Low Income Countries". Master's thesis. University of Virginia. May 2004.

Clemen, R. "Making Hard Decisions: An Introduction to Decision Analysis." Second Edition. Duxbury Press. 1990.

Fukuda-Parr, S., C. Lopes, and K. Malik (eds.). "Capacity for development. New solutions to old problems." London and Sterling, VA: Earthscan and United Nations Development Program. 2002.

International Water and Sanitation Center. "History of Community Management." Online. Accessed March 18, 2003. <http://www.irc.nl/manage/whatisit/history.html>.

Louis, G. "Proceedings of the 2nd Annual Asia-Pacific Landfill Symposium." Seoul Korea, September 2002.

Magpili L. "Community Assessment for Bacoor Case Study." Meeting. April 1, 2004.

Magpili, L. "An Impact-Based Method for the Capacity Planning of Sanitation Services in Lower Income Countries." Dissertation. University of Virginia. August 2003.

United Nations Development Programme. "Principles Guiding the Development of UNDP's Water Programme and Partnerships." Strategy Framework Document: Capacity Building for sustainable management of water resources and the aquatic environment. Online. Accessed March 27, 2004. <http://www.undp.org/seed/water/strategy/4.htm>.

World Health Organization. "Global Water Supply and Sanitation Assessment 2000 Report." April 2001.

Figures

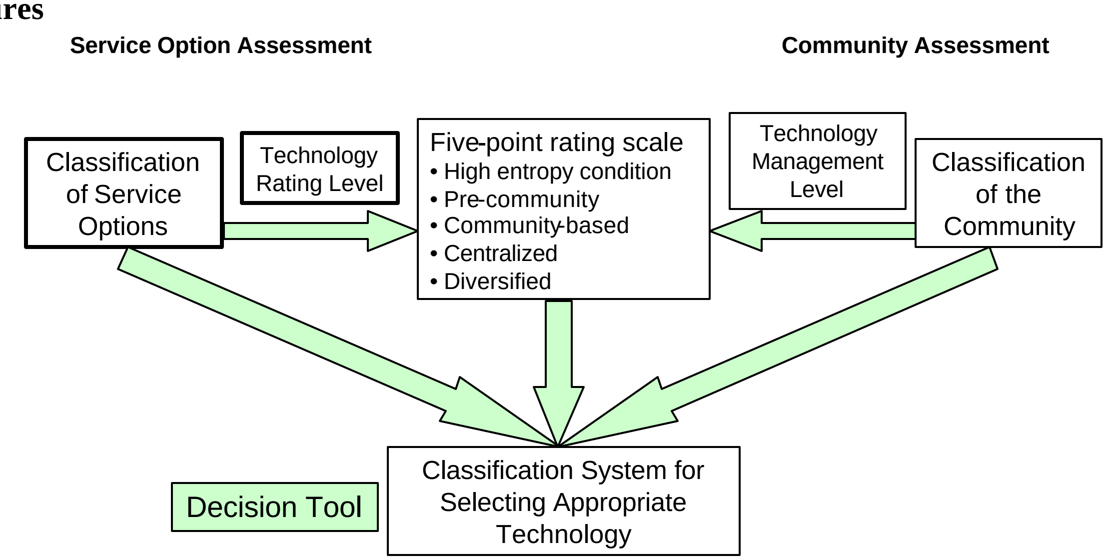

Figure 3-1: Components of the Classification System

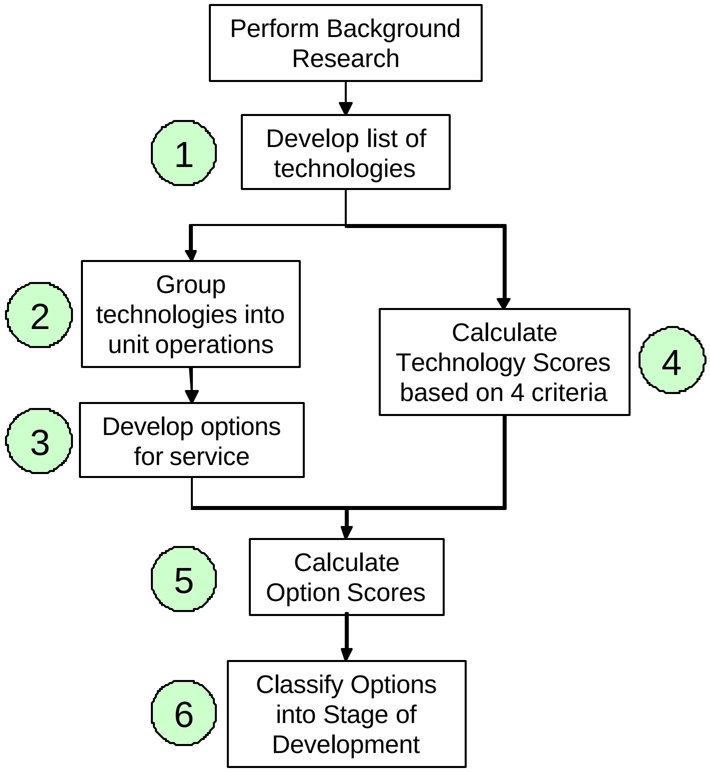

Figure 3-2: Flowchart Mapping Objectives to Options Classification

Tables

	Level		
Criteria	1	2	3
Cost	Low cost	Moderate cost	High cost
Energy	No or minimal energy requirement	Medium energy requirement	High energy requirement
Technical	Low level of technical knowledge	Medium level of technical knowledge	High level of technical knowledge
Institutional	No formal organization needed/Low level of organization	Moderate level of organization	High level of organization

Table 3-1: Criteria mapping to levels

Municipal Solid Waste							
Unit operation	**Technologies**	**Cost**	**Energy**	**Technical**	**Institutional**	**Score**	**NScore**
Storage	Communal bin	Low	Low	Low	Low	4	0.10
	Household bin	Low	Low	Low	Low	4	0.10
Transfer	Human power	Low	Low	Low	Low	4	0.10
	Animal power	Low	Low	Low	Low	4	0.10
	Compactor Trucks	High	High	High	Medium	35	0.88
	Non-compactor Trucks	Medium	High	High	Medium	30	0.75
Disposal	Waste discarded at source	Low	Low	Low	Low	4	0.10
	Open Burning	Low	Low	Low	Low	4	0.10
	Open Dumps	Low	Low	Low	Low	4	0.10
	Controlled Dumps	Medium	Low	Medium	Medium	16	0.40
	Sanitary Landfilling	Medium	Low	High	High	26	0.65
	Incineration	High	High	High	High	40	1.00
Recovery	Composting	Medium	Low	Medium	Medium	16	0.40
	Refuse Derived Fuel	Medium	High	High	High	35	0.88
	Pyrolysis	High	High	High	High	40	1.00
	Recycling/Reuse	Medium	Low	Medium	Medium	16	0.40

Table 3-2: MSW Technology Score

Storage	Transfer	Disposal	Recovery
None	None	None	None
Household bin	Human power	Waste discarded at source	Composting
Communal bin	Animal power	Open burning	Refuse Derived Fuel
	Non-compactor Trucks	Open Dumps	Pyrolysis
	Compactor Trucks	Controlled Dumps	Recycling/Reuse
		Sanitary Landfilling	
		Incineration	

Table 3-3: MSW provision

No	Storage	Transfer	Disposal 1	Disposal 2	Recovery 1	Recovery 2
1	None	None	Waste discarded at source	None	None	None
2	Household bin	None	Waste discarded at source	None	None	None
3	Communal bin	None	Waste discarded at source	None	None	None
4	Household bin	None	Open burning	None	None	None
5	Communal bin	None	Open burning	None	None	None
6	Household bin	None	Open Dumps	None	None	None
7	Communal bin	None	Open Dumps	None	None	None
8	Household bin	None	Open Dumps	Open burning	None	None
9	Communal bin	None	Open Dumps	Open burning	None	None
10	Household bin	None	Controlled Dumps	None	None	None
11	Communal bin	None	Controlled Dumps	None	None	None
12	Household bin	None	Controlled Dumps	Open burning	None	None
13	Communal bin	None	Controlled Dumps	Open burning	None	None
14	Household bin	None	Open Dumps	None	Composting	None
15	Communal bin	None	Open Dumps	None	Composting	None
16	Household bin	None	Open Dumps	None	Recycling/Reuse	None
17	Communal bin	None	Open Dumps	None	Recycling/Reuse	None
18	Household bin	None	Open Dumps	None	Recycling/Reuse	Composting
19	Communal bin	None	Open Dumps	None	Recycling/Reuse	Composting

Table 3-4: MSW options subset

Option Score	Technology Rating Level
0.0 - 0.2	1
0.21 - 0.4	2
0.41 - 0.6	3
0.61 - 0.8	4
0.81 - 1.0	5

Table 3-5: Mapping of Option Score to Development Stage

No	Storage	A	Transfer	B	Disposal 1	C1	Disposal 2	C2	C3 Max C1,C2	Recovery 1	D1	Recovery 2	D2	D3 Max D1,D2	Option Score	Tech Rating Level
1	None	0	None	0	Waste discarded at source	0.1	None	0	0.1	None	0	None	0	0	0.024	1
2	Household bin	0.1	None	0	Waste discarded at source	0.1	None	0	0.1	None	0	None	0	0	0.049	1
3	Communal bin	0.1	None	0	Waste discarded at source	0.1	None	0	0.1	None	0	None	0	0	0.049	1
4	Household bin	0.1	None	0	None	0	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
5	Communal bin	0.1	None	0	None	0	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
6	Household bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	None	0	None	0	0	0.049	1
7	Communal bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	None	0	None	0	0	0.049	1
8	Household bin	0.1	None	0	Open Dumps	0.1	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
9	Communal bin	0.1	None	0	Open Dumps	0.1	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
10	Household bin	0.1	None	0	Controlled Dumps	0.4	None	0	0.4	None	0	None	0	0	0.122	1
11	Communal bin	0.1	None	0	Controlled Dumps	0.4	None	0	0.4	None	0	None	0	0	0.122	1
12	Household bin	0.1	None	0	Controlled Dumps	0.4	Open burning	0.1	0.4	None	0	None	0	0	0.122	1
13	Communal bin	0.1	None	0	Controlled Dumps	0.4	Open burning	0.1	0.4	None	0	None	0	0	0.122	1
14	Household bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	Composting	0.4	None	0	0.4	0.146	1
15	Communal bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	Composting	0.4	None	0	0.4	0.146	1
16	Household bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	Recycling/Reuse	0.4	None	0	0.4	0.146	1
17	Communal bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	Recycling/Reuse	0.4	None	0	0.4	0.146	1
18	Household bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	Recycling/Reuse	0.4	Composting	0.4	0.4	0.146	1
19	Communal bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	Recycling/Reuse	0.4	Composting	0.4	0.4	0.146	1

Table 3-6: MSW Option Scoring

Capacity Score Summary Table	
Capacity Factor	**Score**
Institutional	34.20
Human Resource	60.50
Technical	18.00
Economic	27.17
Energy	40.50
Environmental	10.00
Social and Cultural	10.00
Service	21.00
Environmental Social and Cultural	**10.00**
Technology Managment Level	**1**

Table 6-7: Capacity Score Summary

Capacity Score	Technology Management Stage
0 - 20	1
21 - 40	2
41 - 60	3
61 - 80	4
81 - 100	5

Table 6-8: Mapping of Capacity Score to Development Assignment

No		Option No	Storage	A	Transfer	B	Disposal 1	C1	Disposal 2	C2	C3 Max C1,C2	Recovery 1	D1	Recovery 2	D2	D3 Max D1,D2	Option Score	Technology Rating Level
1		1	None	0	None	0	Waste discarded at source	0.1	None	0	0.1	None	0	None	0	0	0.024	1
2		2	Household bin	0.1	None	0	Waste discarded at source	0.1	None	0	0.1	None	0	None	0	0	0.049	1
3		3	Communal bin	0.1	None	0	Waste discarded at source	0.1	None	0	0.1	None	0	None	0	0	0.049	1
4		4	Household bin	0.1	None	0	None	0	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
5		5	Communal bin	0.1	None	0	None	0	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
6		6	Household bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	None	0	None	0	0	0.049	1
7		7	Communal bin	0.1	None	0	Open Dumps	0.1	None	0	0.1	None	0	None	0	0	0.049	1
8		8	Household bin	0.1	None	0	Open Dumps	0.1	Open burning	0.1	0.1	None	0	None	0	0	0.049	1
9		9	Communal bin	0.1	None	0	Open Dumps	0.1	Open burning	0.1	0.1	None	0	None	0	0	0.049	1

Table 6-9: Feasible MSW service options for Bacoor, Philippines