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**SUSTAINABILITY AND REPLICATION OF
COMMUNITY-BASED COMPOSTING – A CASE STUDY
OF BANGLADESH**

**By
TARIQ BIN YOUSUF**

**A Doctoral Thesis submitted in partial fulfilment of the requirements
for the award of the degree of Doctor of Philosophy of Loughborough
University**

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ABSTRACT

Solid waste management is a key concern for the local authorities in developing countries. The continued generation of solid waste, increasing waste management costs and scarcity of landfill space have compounded solid waste problems to a serious stage. Local authorities struggling to meet collection targets do not usually think of waste reduction and recycling. Composting is seen as one potential waste reduction strategy through the recycling of waste. As a result, a number of community-based composting projects have been piloted in the cities. Some projects have been successful in producing lasting impacts on the improvement of solid waste management. However, many projects could not support themselves or expand further when the external agencies discontinued their support. This thesis is an attempt to study the state of sustainability and replication potential of four community-based composting operations in Bangladesh. Four broad aspects were investigated: (i) community awareness and participation (ii) Local government perceptions and attitudes (iii) financial viability and (iv) demand and marketing. A multi-method approach, including questionnaire-based surveys, interviews, group discussion, observation and document survey was used in collecting data. The main findings of the study indicate that sustainability and replicability of the community-based composting projects are not possible under existing conditions. A sustainable and replicable composting model would require an integrated approach of community, government and business in collaboration with other stakeholders. In this model, the community should organise primary waste collection, private enterprise should operate the composting facility and local government should facilitate by diverting some of the financial savings to the composting projects.

Key words: Solid waste management, sustainability, replication, community-based project, community participation, local government, financial viability, demand and marketing, partnership.

Dedication

This thesis is dedicated to the waste pickers and the waste professionals who really give value to waste as a resource.

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List of Abbreviations

- ADB – Asian Development Bank
ADBI – Asian Development Bank Institute
BARC – Bangladesh Agriculture Research Council
BBS – Bangladesh Bureau of Statistics
BIEDF – Bangladesh Integrated Environmental Development Forum
CBO – Community Based Organisation
CEE – Centre for Environmental Education
CUS – Centre for Urban Studies
DAE – Department of Agriculture Extension
DCC – Dhaka City Corporation
D-CL – Dhalpur Community Leader
GDP – Gross Domestic Product
GNP – Gross National Product
GR-CL – Green Road Community Leader
KCC – Khulna City Corporation
KCDC – Karnataka Compost Development Corporation
LIFE – Local Initiative Facility for Environment
MOA – Ministry Of Agriculture
MoU – Memorandum of Understanding
M-CL – Mirpur Community Leader
NGO – Non Governmental Organisation
PPCP – Public-Private-Community Partnership
SCC – Sylhet City Corporation
SEMP – Sustainable Environmental Management Programme
SWM – Solid Waste Management
UNDP – United Nations Development Programme
UWEP – Urban Waste Expertise Programme
WEDC – Ward Environmental Development Committee
WMC – Waste Management Committee
WSP – Water and Sanitation Programme

CHAPTER-1

INTRODUCTION

1.1 General

Solid waste is one of the most visible and pressing urban environmental problems in the developing cities. Urbanisation, demographic growth and economic development all contribute to the generation of waste, which overloads the capacities (budget, personnel and infrastructure) of the local authorities. Landfill, the easiest way of waste disposal, is becoming difficult and costly. The dump sites are gradually exhausted and suitable lands for landfill are becoming scarce and expensive near the cities. Moreover, the environmental regulations for the protection of public health and environment are becoming more stringent. The growing generation of solid waste, rising waste management cost and declining landfill space, compounded with a lack of financial resources and management problems, has given rise to the idea of waste reuse and recycling as a solution to the waste management problem for the local government authorities.

Local governments of both the developed and developing countries are generally concerned for the environmental consequences of waste disposal. The developed countries are looking for means to minimise the amount of waste entering landfills to meet waste diversion targets and to extend landfill life. The developing countries are thinking to facilitate community initiatives for waste reduction and recovery.

It is acknowledged that land filling waste is both environmentally damaging and unsustainable (Barton et al. 2001). The current trend of waste management is towards effective utilisation of resources, reduction of waste quantity, protection of natural resources and development of economic activity based on a sustainable approach (Wilson 2000). However, the management approach of developing countries is remarkably different from that of developed countries. While the developed countries are moving towards reaching the higher desirability hierarchy of minimising the effects of waste through sophisticated waste treatment and recycling technologies, the developing countries are struggling with the improvement of waste collection and disposal services (McDougall and Fonteyne 2000).

Composting has potential as an alternative to landfill for managing a proportion of the domestic biodegradable waste stream, although it has not been overwhelmingly successful and widespread in practice throughout the developing world. Although such countries have had the largest number of failed facilities worldwide (UNEP-IETC 1996), there are also some well documented successful composting initiatives that have been implemented at the house-hold or community level. This thesis is looking into community organisation and support, administrative and political orientation of the local government and the economics of small-scale community-based composting projects for their sustainability and replication in the cities of Bangladesh.

1.2 Problem statement

The increasing amount of solid waste in the cities is a critical issue. The projection of the World Bank (1999) indicates that about 52 percent of the population in the developing countries of Asia will be living in urban areas by the year 2025 and they will be generating three times the present amount of municipal waste. The waste quantities and urban per capita municipal waste generation of the current and projected year (2025) are shown in Tables-1.1 & 1.2 and clearly indicate an alarming picture in both low and middle income countries. This dramatic increase in waste generation will obviously place enormous stress on limited financial resources and waste management systems of the local government institutions. However, the per capita municipal solid waste generation rate in high income countries is likely to remain stable or decrease slightly due to their waste minimisation programmes.

	Current waste quantities	Year 2025 waste quantities	Percentage increase
Low income	158,000,000	480,000,000	204%
Middle income	34,000,000	111,000,000	226%
High income	85,000,000	86,000,000	1%

Source: World Bank, 1999

	Current urban population (% of total)	Current urban MSW generation	Year 2025 urban population (% of total)	Year 2025 urban MSW generation	Increase in urban population	Increase in MSW generation rate
Low income	27.8	0.4-0.9	48.8	0.6-1.0	21%	0.2
Middle income	37.6	0.5-1.1	61.1	0.8-1.5	23.5%	0.3
High income	79.5	1.1-5.07	88.2	1.1-4.5	8.7%	(-0.57)

Source: World Bank, 1999

Now the problem is where to put the waste and in what form? Can it be minimised by adopting strategies to save the capacity of landfill sites and to lessen the potential environmental impact of waste?

Various technological options have been tested to find viable alternatives for the appropriate disposal of waste. These experiments have established the fact that solid waste management is not just a technical or financial issue; it has socio-political and cultural dimensions as well. Today, it is being increasingly realised that solid waste management can be a strategy for resource conservation and protection of the environment. In the developing countries, inorganic wastes such as paper, plastic, glass, metal are recycled and reused in a regular manner by the input of the informal sector. The organic wastes such as vegetables and food leftovers can be converted into valuable agricultural inputs by composting. Despite its potential resource value, the recycling of organic waste by composting has been much more limited, currently only 1 percent of the total wastes in the developing countries (Suryodipuro 2004). This research addresses the recycling of organic wastes by composting which converts urban organic waste into a useful resource nearer to the point of generation.

The history of composting in the developing countries has not been a positive experience. The reason for this is that in the past, the economic advantages of composting were overestimated. Large and sophisticated composting plants were constructed which did not fulfil expectations. Only a few plants were working at planned capacity, many were running below capacity and a substantial number have been closed down. Apart from the technical and organisational difficulties in compost production, it is above all the sale of compost which causes the most problems and makes the composting plants uneconomical (UNEP-IETC 1996). Pilot projects of

small-scale composting propagated through local NGOs and community-based organisations (CBOs) are found suitable in the developing countries in consideration of climatic condition, waste characteristics and socio-economic settings (Hoorweg et al. 1999; Diaz et al. 1996).

Urban solid waste composting has experienced multiple problems: of a general lack of environmental concern in the community, of local government priorities, of feedstock material, of plant operation, of the quality and price of the product, of the consumers' perception of value, and of institutional support and marketing (Furedy 2004; Daskalopoulos et al.1997). In community-based waste management, the community role is not limited to being service receivers or beneficiaries; they can also become a collaborative force to participate in waste reduction, source separation and composting projects (Perla 1997). Asomani-Boateng et al. (1996) found difficulties in executing community-based composting projects in African cities; these included the difficulty in convincing households to perform source-separation, negative attitudes of waste management officials, lack of space in high density residential neighbourhoods and residents' lack of knowledge about composting. Local government authorities in the developing countries do not have clear national goals and priorities pertaining to waste reduction and minimisation measures, implementation of recycling programmes and improvement of the disposal procedures (Diaz et al. 1999). Local government authorities are traditionally responsible for collection and disposal of municipal waste. Although the local government institutions have the authority to deal with solid wastes as the service provider, their roles are gradually shifting to becoming facilitators by providing lands and other logistics for the community activities (UNEP-IETC 1996; Furedy 1992). It is evident that there is a role for both the community and the local government authority in community-based composting projects.

The decision makers can identify suitable alternatives both from the technical as well as the economic point of view. The technical reliability and performance of the composting project is important. However, due to low financial investment, the open windrow composting method is being practised despite its limitations in control over temperature, aeration, moisture content and large land requirement (Gray et al.1973; Rabbani et al. 1983). The technical aspect of the community-based composting project is beyond the scope of this research. Ensuring financial sustainability is a prime requirement of the composting projects. There were many failures, others

struggled to break even and a few seemed to make a profit. The continuation of a project after the end of external support can be ensured by a financially sustainable mode of operation. Financial sustainability is characterised by such aspects as capital investments, operational financing, cost recovery and profits, and economic principles of the projects (Schubeler 1996).

Composting is a process which converts urban organic wastes into a useful agricultural input for replenishing organic matter of the degraded agricultural soil. Most of the developing countries are highly dependent on agriculture for subsistence and for economic development. Therefore, conservation of soil quality and maintenance of soil productivity are very important concerns (Diaz et al. 1999). Composting establishes a link between organic waste recycling and urban agriculture, whereby organic wastes generated in the cities stay in the cities. Composting projects in the developing countries have a history of failure due to insufficient knowledge of the value and possible uses of organic wastes, poor product quality and price, lack of demand and market planning (Hart and Plumers 1996). From the above discussion, the following key areas of the composting projects are found necessary for their sustainability and replication:

- Community organisation and support
- Administrative and political orientation of the local government authority
- Economic feasibility, and compost demand and marketing.

1.3 Composting in the developed and developing countries

Composting has a long history of use, although not as a waste management approach. Currently, there is a growing interest on the part of local governments, both in the developed and developing countries, to incorporate composting into their integrated solid waste management system. Composting is a technically feasible and environmentally favourable option for waste management, which transforms urban wastes into a resource, reduces wastes for disposal, preserves health and protects the environment from pollution. In a broader sense, composting can contribute to poverty alleviation, create social harmony, protect the environment and provide environmentally friendly and sustainable urban development. In the developing countries, composting projects are espoused for establishing important links between

environmental management, income generation and community development. In the developed countries, issues surrounding the management of organic waste by composting have become more significant because of strong anti-incineration sentiments and restrictions on use of biodegradable waste for land filling (Daskalopoulos et al. 1997).

Over the last 30 years, most of the city governments in the developing countries had opted for large-scale composting plants without studies of the potential markets or the likely overall costs. Within a short period, most of the plants failed or were scaled down due to advances in technology, difficulties in operation and maintenance and unrealistic expectations with regard to markets and prices for the compost. The high technology approach has now been shelved in favour of a small-scale community-based approach for its low cost and labour intensive technology (Zurbrugg and Arisanti 1999).

During the 1970s and 1980s, the developed country focus was on large-scale centralised composting to treat mixed municipal solid waste. The resulting compost was of low quality, often heavily contaminated by inorganic fractions (glass, metal and plastic) and heavy metals. The compost was unsuitable for application as a soil conditioner and the interest in composting diminished. During the 1990s, there had been a resurgence of interest and success in large-scale composting, as waste management had begun to emerge in the developed countries as a scientific and engineering profession. Environmental standards and sophisticated technology have been developed in parallel. The political priority was given to the public concern over the contaminated nature of the composted materials and policy exhibits a trend towards rapid development of source segregated organic waste composting (Barth and Kroeger 1998).

The success of the composting projects in the developed countries lies in the more capital intensive mechanised option with a high degree of waste segregation. Legislation, landfill tax and higher environmental standards encourage the development of composting projects in the developed countries. Composting projects in developing countries are mostly small-scale demonstration projects and are undertaken with the objective of cleanliness of the community and for employment of the urban poor.

Bangladesh is a tropical country most favourable to composting. Waste is mainly organic in nature leading to composting as an appropriate waste disposal option.

According to BARC (1999), 50 percent of the agricultural lands of Bangladesh have an organic matter content of less than 1 percent which would create a potential demand for compost. Consequently small-scale community-based composting projects are being piloted in the major cities of Bangladesh with the objective of reducing the amount of waste being disposed of in landfill, placing value on waste as a resource and recycling it into a product which can be used to improve soil texture and crop yields. All the composting-projects are at an early stage and fully dependent on donor support. This study takes the scope of research to look into the sustainability and replication of the composting projects.

1.4 Theoretical framework

In the last few decades, a number of solid waste management projects have been carried out in the developing countries, in collaboration with external support agencies. Some of these projects were successful in producing long lasting improvements in solid waste management. However, many projects could not support themselves or expand further when the external agencies discontinued their support (Ogawa 2003). A number of technical, financial, institutional, economic and social factors were responsible for failure of the projects. The projects were initiated with specific aims and expected outputs, but their scope was not sufficiently comprehensive. The external support agencies often do not fully understand socio-economic, cultural and political factors influencing the selection of appropriate solid waste management systems. Development of self-financing schemes and participation of the community and decision makers can significantly improve the sustainability of solid waste management projects.

CITYNET (1992) outlined the process of a community-managed environmental infrastructure and services model (Fig 1.1) in Jakarta, Indonesia which could be adopted as a self-sustaining and replicable model for community-based solid waste management. In this model, people's priority fixation, involvement in design and management, and financing the project activities are proven as important elements of a self-sustaining and replicable model.

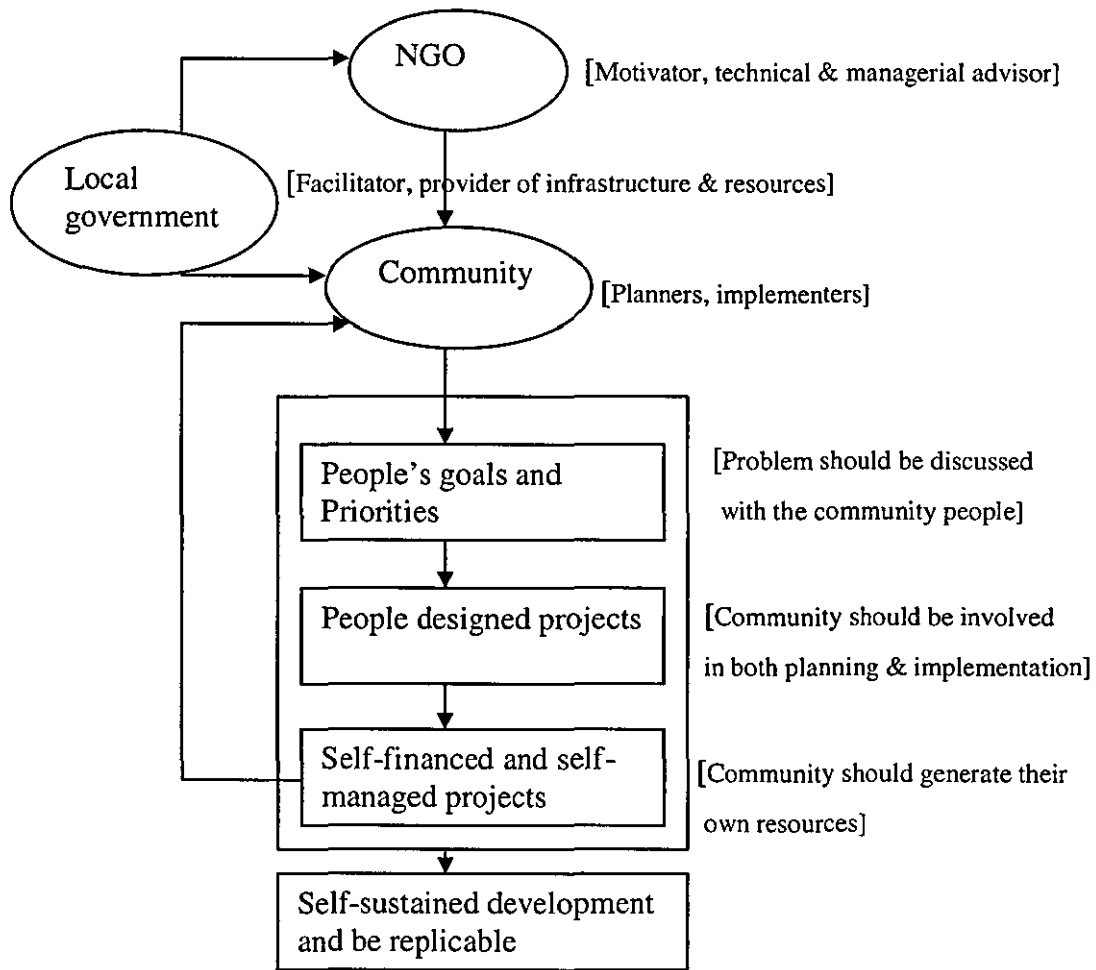


Fig 1.1 Community-managed environmental infrastructure and service model

However, the community-based composting project is not merely a technical solution; it is an integrated approach of government, civil society and business in the context of socio-political, environmental and economic dimensions. SKAT (2000) adopted a diagrammatic representation of sustainable and integrated solid waste management (Fig 1.2) which is slightly modified for theoretical understanding of sustainability and replication of community-based composting projects.

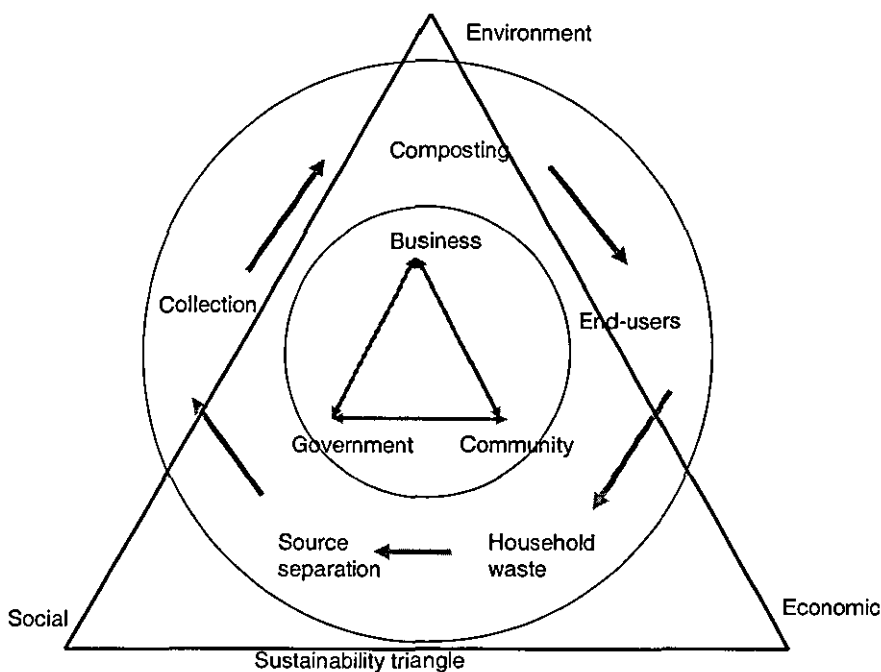


Fig 1.2 Sustainable and integrated waste management triangle

1.5 Justification of the research

Solid waste is an emerging problem and a potential crisis in the cities because of increasing quantity, shrinking landfill capacity, rising cost, and shortage of landfill space in the cities. There is an informal chain of management consisting of scavengers, itinerant buyers and small industries for the inorganic wastes (Ali 1997). The organic waste, which comprises nearly two-thirds of the total amount of waste, has not been utilised much but simply dumped in an environmentally threatening way. Composting has proved to be an efficient waste management option which can reduce and stabilise organic waste and thus minimise the adverse impact on the environment. Solid waste management, in particular organic waste recycling, has so far been the most ignored and least studied area in environmental sanitation in most of the developing countries. Waste collection and disposal have only been of technical and economic significance in the developing countries. But recently it has created a general concern. Now recovery and recycling are being considered as important management tools for solid waste management. In response, community-based composting projects have been developed which are integrated with the primary waste

collection services. These projects are mostly supported by external assistance and valued for the positive social and environmental credence, such as creating employment for the urban poor, and raising environmental awareness within the community. This research will determine the sustainability and replicability issues of such community-based composting projects. These issues include not only the technical solution of wastes and the assessment of social and environmental feasibility but a broader holistic approach and examination of the community engagement, political motivation and attitude of the local government, financial situation and commercial opportunities. No theoretical framework has yet been developed to look into the sustainability and replicability issues. This research will examine the issues on the basis of the waste literatures, economics and marketing and will then develop a community-based composting model for the policy makers and the implementors.

1.6 Scope of the research

This research is limited to community-based composting projects which are low-cost, labour-intensive and adaptable to the socio-economic condition of developing countries similar to Bangladesh. The research will take place in an environment where there is no legislation towards recycling and no clear role for the business sector. This research is based on multiple case approaches, with scope for discussion of the potential and limitations of each case, and is helpful in designing an appropriate and generalised model of waste management for the cities of Bangladesh as well as other developing countries with a similar socio-economic and political culture.

There are three core considerations of relevance to this thesis; projects should be community-based, sustainable and replicable. Community-based defines the approach for management of the generated solid waste within the community in which community residents can facilitate the project activity by providing support in cash or in kind. A sustainable project is one with the capacity to function without external assistance or which achievement will continue after the stipulated project period. A replicable project is one that achieves success, obtains institutional and financial sustainability and can be executed in other places in a similar socio-economic and cultural setting.

The broad aim of the research is to encourage organic waste recycling for reduction of waste at source and for effective exploitation of the resource value of the waste. The specific aim is to measure the sustainability and replicability of the community-based composting projects through consideration of issues as community participation, local government perception and attitude, financial and operational performance, and compost demand and marketability. The research is guided by the hypothesis that community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered.

1.7 Structure of the thesis

The thesis is based on a case study approach and structured in a logical order of case investigation, findings and recommendations for a generalised model. **Chapter-1** introduces the research by encompassing the problem area, discussing the theoretical framework and elaborating the scope of the research. **Chapter-2** reviews local and international literature of both published and electronic sources pertaining to various aspects of composting, with particular emphasis on sustainability and replicability. **Chapter-3** designs the different investigation procedures for data collection and analysis. **Chapter-4** presents the cases with their background and activities and the state-of-the-art situation of community development and its constraints. **Chapter-5, 6, 7, and 8** analyse the different aspects of community-based composting such as community participation, local government attitude, financial viability, and demand and marketing of compost. **Chapter-9** discusses the key findings and integrates them to design a general model for the policy makers. Finally, **Chapter-10** makes some recommendations on the research area and discusses further scope for research.

Preliminary

Chapter-1:
Introduction

Chapter-2:
Literature review

Chapter-3:
Research design and field work
methodology

Chapter-4:
Overview of community-based solid waste
management in
Bangladesh

Analysis

Chapter-5:
Community awareness and
participation

Chapter-6:
Local government perceptions and
attitudes

Chapter-7:
Financial viability of composting
project

Chapter-8:
Demand and marketing of compost

Chapter-9
Summary of results

Chapter-10
Conclusion

Conclusions

1.8 Summary

Solid wastes in the cities are rising in an alarming level that is both difficult and costly to manage. Composting is an effective way to reduce the waste at source and to recover potential resources; it represents waste not as a problem but as a resource in the sustainable development paradigm. Community-based composting is important because it is appropriate to local conditions and feasible from a technical, environmental, social, economic and institutional perspective. It has to be sustainable to maintain itself over time and be replicable in the cities to go some way to solving the waste problem. This research leads to the development of a sustainable and replicable community-based composting model for cities with similar socio-economic characteristics and political settings to those in Bangladesh.

CHAPTER 2

Literature Review

2.1 Introduction

Solid waste management is a key area for concern of the local authorities. The continued generation of solid waste, increasing waste management costs and scarcity of landfill space have compounded solid waste management problems to a serious stage. Local authorities struggling to meet collection targets do not usually think of waste reduction and recycling. Composting is seen as one of the potential waste reduction strategies to recycle waste quantities. As a result, a number of community-based composting projects have been piloted in the cities, but these projects are still in their infancy. This study looks into the sustainability and replication potential of the community-based projects. The literature review is therefore organised around the core concepts of:

- Sustainability
- Replicability
- Waste disposal strategy
- Community participation and community-based project
- Local government participation
- Financial aspects of composting
- Demand and marketing strategies for compost.

The key purpose of the research is to measure the sustainability and replicability of community-based composting projects with an ultimate goal of developing a sustainable and replicable waste management model for the decision makers as a solution to the city waste problem. This chapter presents a review of literature relating to the sustainability and replication of community-based composting projects. Community-based solid waste management is a relatively new area of research. No theoretical framework for the sustainability of community-based solid waste management projects has yet been developed. The other literatures such as water, sanitation were reviewed as the main basis for finding out about indicators of sustainability and replication in community-based projects. In addition this study

covered theories of economics and marketing as guidelines to the research problem.

The literature review is structured around the following objectives:

- To overview the solid waste management situation, its trends and development in the context of waste reduction and recycling.
- To find out the contribution of organic waste disposal practices in response to predicted landfill shortage and to identify the limiting factors of community composting as a disposal option for municipal solid waste.
- To look into the participation of different stakeholders in the community participatory processes, their integration and particularly the political environment in the local government institutions in support of community activities.
- To measure the financial aspects of composting in terms of full cost accounting principles.
- To explore the potential and constraints of compost demand and marketing and its commercial viability.

2.2 Review approach

The main purpose of the literature review is to explain the related concepts and to find out the research gap in the proposed field of study. To discover the key area of research, the relevant publications in journals and periodicals, internet sources, reports and books were studied through literature search engines. In the initial stages, to gain a general understanding of the research topic, theoretical books were read for developing the research base. The following web-sites were visited and were found to provide a rich body of literature on this particular area of research:

- www.waste.nl
- www.sandec.ch
- www.wri.org

The relevant journal articles were searched in ingenta (www.ingenta.com) and science direct (www.sciencedirect.com) through the university library e-journals link. The following journals or periodicals were quite often though not exclusively reviewed:

- Warmer Bulletin
- Resources, Conservation and Recycling
- Journal of Environmental Management
- Bio-cycle
- Journal of Solid Waste Technology and Management
- Waste Management and Research
- The proceedings of Chartered Institute of Waste Management, UK

Some of the journal copies were managed through the inter-library loan arrangement. At the onset of the study, through MetaLib, abstracts from the different research databases were reviewed and summarised using different combination of keywords-composting, community, demand, marketing, sustainability, replication. Quite often a Google search was sought for electronically published information. The literature sources were managed by using ENDNOTE 4 and are presented in the bibliography.

2.3 Sustainable Waste Management

The term 'Sustainable development' brings together the concerns of both the environment and development. The concept of sustainable development first emerged from the Brundtland Commission in 1987 and aims in balancing economic development and environmental conservation with an objective that every development project should achieve environmental, technological, social and financial sustainability both in the present and in the future. *'Most of the development projects focus on the environmental part of sustainable development, but sustainable development in a broader concept meaning that the environmental, social, technological and economic development should be accounted for in achieving a healthy, productive and quality life both for the present and the future generation'* (HED 1999). The concept of sustainable development in waste management gained prominence from the United Nations Rio Conference in 1992 on Environment and Development, commonly known as the Earth Summit, in which sustainable solid waste management was defined in a framework of environmental, social, economic and institutional aspects:

- to minimise the generation of waste both in the production and in the consumption site.
- to make maximum use of waste by promoting reuse and recycling activities.
- to minimise pollution from waste in the surrounding environment by utilising it in a closed-cycle system.

In this conference, in Agenda 21 the global consensus was reached that sustainable development could be achieved through local level solutions (Heisler 2004). Sustainable development is not a big word for big things. Sustainability efforts start from each of our houses. By sorting out household waste, we can contribute to sustainability at a local level. By avoiding indiscriminate littering of waste or putting waste in a proper place, we can contribute to sustainability at the community or city level. By avoiding the burning of waste or doing composting at household or community level we can contribute to global level sustainability by minimising green house gas emission.

The sustainable waste management system in question develops the concept of 'Integrated Waste Management' which broadens the scope of waste management from mere technical and financial to multi-disciplinary and multi-stakeholders participation (Klundert and Anschutz 2000). Integrated waste management is a holistic approach where waste streams, collection system and treatment methods, as well as environmental benefit, economic optimisation and social acceptability, could all be addressed in a systematic manner in a well defined framework (Klundert and Lardinois 1995). But the question is what should come first - the environmental, social or economic issues? A difference of opinion exists between environmentalists, economists and sociologists. But in reality, the waste managers give first priority to economic viability and secondary to social acceptability and environmental benefits (McDougall and Fonteyne 2000). Hence, solid waste management needs to be economically sustainable in order to provide a service at an affordable cost, socially acceptable through a process of public consultation and information campaigns, and finally environmentally sustainable in order to reduce overall environmental burdens. Individuals, households and communities are essential partners in sustainable development efforts. As a community is better able to identify and analyze problems, evolve strategies and solutions and interact with local authorities, so community initiated and participated projects are able to be sustained for a long time (Weisburd et al. 2004).

Summary from the section

- Sustainable solid waste management is appropriate to local conditions and feasible from a technical, environmental, social, financial and institutional perspective.
- Sustainable solid waste management fits well with the current global trend of community-based approaches to environmental problems.

2.3.1 Sustainability of community-based projects

Sustainable development will be used in this research context as sustainability of development projects. Sustainability of projects means that the achievements that obtained from the project will continue over a longer period of time. Schubeler (1996) defined sustainability as the long-term physical, financial and institutional stability of the project. Sustainability has two generic meanings- the longevity and the continuation. In this research, the term 'sustainability' will be used to mean 'the continuation of the projects after termination of the project fund' i.e. the projects do have the capacity to function without external assistance. White (1987) described sustainability as the ability of a project to sustain itself throughout the duration of the project and into the future. Moningka (2000) laid emphasis on capacity building of the community and follow-up support. He argued that without the follow-up support, it will be difficult for the community to continue the services on its own. He also added that during the project period, a mechanism of support needs to be created or community resources mobilised in order to sustain the activity without relying solely on external support. White (1987) supported the view that community-based initiatives may benefit from the initial support of external agencies. But there is a risk that community-based initiatives become dependent on external support. Dependence on external support may be a threat to the sustainability of this type of initiative. Moningka (2000) pointed out that the sustainability of the community-based projects can be achieved by:

- Involvement of the community in the whole project cycle from project design to implementation. This ensures the reflection of community needs, priorities and motivations, and encourages the community in cost-sharing and builds the capacity of the community for operation and maintenance of project activities.

- Transferring the project management to a local group or agency for maintaining the lasting impact of the project.
- Growing the sense of responsibility and ownership of the project by the local community for maintaining the services of the project.

White (1987) identifies seven key factors influencing the sustainability of any community- based project:

- The project must result from a felt need of the beneficiary community.
- Contribution of the community in the project design.
- A continuing base of financial resources must be secured.
- Management capacity must be developed.
- Project must enjoy sufficient commitment and leadership from the community.
- The project must achieve political support.
- Co-ordination and co-operation between different stakeholders.

McCommon et al. (1990) studied water and sanitation projects and found that for the sustainability of community managed projects the pre-conditions are:

- Community must have demand and positive attitude towards the project.
- Community must have information accessibility.
- Community must feel responsible for and empowered to take control of the project.
- Community must be willing to undertake cost-sharing and have the institutional capacity to manage the project.

Sohail et al. (2001) placed emphasis on institutional structure and the feeling of ownership among the community residents for its sustainability. Ali (2003) recommended that social capital, community contribution, ownership and political will of the local government would lead to the achievement of sustainability whereas political influences, irregular payment by the community and cost recovery were threats to sustainability.

Summary from the section

It can be summarised from the water and other infrastructural literature that for the sustainability of the community-based projects, community participation is essential. The role of community should be extended to:

- Contributing to the project cycle from project planning to implementation.

- Enhancing the capacity of the community to run the project by itself.
- Growing the sense of responsibility or ownership of the project.
- Expanding project resources and political support.

2.3.2 Replication of community- based projects

When the community-based projects are successful and have obtained institutional and financial sustainability, they can be executed in other places. This refers to the concept of replication which means *'to duplicate the process to obtain its benefits in a new location after its effectiveness has been demonstrated in one area and the experience gained from it has a multiplier impact'* (Narayan 1995). The Orangi Pilot sanitation project was replicated in 46 settlements in Karachi, Pakistan. The main motivation behind this successful sanitation model was that people could manage, finance and build the project by themselves. The successful and unsuccessful replication cases of OPP-RTI (Orangi Pilot Project - Research and Training Institute) model acknowledge the necessity of local community organisations and the importance of ownership, political willingness and support, and the institutional and financial capacity of the community organisations (Box 2.1).

Box 2.1 Replication of OPP-RTI model in Karachi, Pakistan

Through NGOs and CBOs

Initially, the OPP-RTI tried to replicate its model in various locations in Karachi but it had experienced that the model could not be replicated without a local organisation taking over the responsibility of social mobilisation and technical support. This realisation led the training of local activists and the mobilisation of community organisations. Local educated young people were best suited to carry out the programme because they were interested to work in their locality and had no problem of continuing to live and work there. The work enhanced their image and reputation in their localities and they emerged as leaders. This provided them an incentive to continue working and to own the organisation with which they worked and they felt that they were working belong to their communities.

Through Government Agencies and Donor support

This was the collaboration project of the OPP-RTI with Karachi Municipal Corporation (KMC) with ADB funded programme. The project was successful because the Mayor of the KMC at that time was a friend of the OPP-RTI co-ordinator and took personal interest in the initiation of the project.

The unsuccessful case of OPP-RTI for replication

UNICEF's Urban Basic Services programme in Sukkur (Karachi) and the World Bank-Swiss Development Cooperation (SDC) in Hyderabad failed to accommodate the OPP-RTI model because (i) The local government departments involved in project management were never consulted in the initial decision making (ii) Before designing the institutional arrangements of the projects internal politics, the organisational culture, technical capacity and capability and financial problems of the Sukkur and Hyderabad Municipal councils were not taken into consideration.

(Source: Hasan 2001)

SEVANATHA, an urban based NGO in Sri Lanka has experimented with the use of compost bins as a solution to household waste disposal since 1997 and has successfully replicated this community-based solid waste disposal system in Colombo as well as in other urban areas of Sri Lanka. According to the experiences of Chularathna and Ratnayake (2000), three types of programme were implemented addressing different socio-economic levels of urban population:

- Pilot projects in urban low income settlements implemented by SEVANATHA with donor support.
- Pilot projects implemented by local government authorities.
- Middle and high income households purchased the bins individually.

The strategies taken by the NGO for replication of the compost bin system were:

- Convincing community and local authorities through demonstrations
- Let communities explain their experiences rather than the NGO expressing its views
- Trying to make it a people's programme for its instinctive ownership than involving external interventions.

Summary from the section

Replication of the community-based project can be achieved through:

- Building awareness and knowledge of the community people.
- Political support and willingness of the government
- Local ownership and commitment of the community

2.3.3 Scaling-up of community-based projects

Replication is sometimes interchangeably used with scaling-up. The dictionary meaning of scaling-up is increasing the size or expanding the service. Scaling-up is not limited to merely expanding size or coverage, but also encompasses the expansion of functions and extension of service delivery. Lockwood (2004) described scaling-up as:

- Successful and sustainable approach maintained at an expanded scale.
- Improved and sustainable services provided to the vast majority.

- Ensuring adequate and sustained capacity to build up and change the focus from implementation of a small-scale decentralised solution to the entire solution.

He also explained the types and main elements of scaling-up the community-based projects.

Types of scaling-up

- Quantitative scaling-up: An organization can scale-up by increasing the size and number of their programmes depending on its geographic area or its budgets or its needs and suitability.
- Functional scaling-up: A community-based programme or a grass root organization expands the number and the type of its activities (e.g. starting in health an organization can extend its activities into credit, literacy, environment, nutrition etc.)
- Political scaling-up: Participating organization has to extend the services beyond its capacities due to political influence and involvement.
- Organizational scaling-up: Community based programmes can increase their organizational strength so as to improve the effectiveness and efficiency of their activities.

Main elements of scaling-up

- Detailed assessment of the full cost is one of the first steps for planning to go to scale.
- Selection of technology is very important for scaling-up because higher levels of complexity and service will generally demand greater management capacity.
- Scaling-up requires supporting a positive enabling environment to influence and modify sector policies and legislations.

Summary of the section

Community-based projects can be scaled-up by political support; this needs management capacity and sound financial budget.

- Political decision is vital which can push forward the programme of scaling-up.
- Capacity building is also a crucial element of scaling-up the project activities.

- Financing is the greatest challenge to scaling-up efforts.

2.4 Development trend of waste disposal and treatment

Waste generation is unavoidable in our daily life. It is inextricably linked with resource consumption, urban lifestyle and economic development. According to environmental historian Martin Melosi (1983), since human beings have been on the earth, there has been generation of waste and its associated problems.

In the early days, waste management systems were largely based on the 'dispose, dilute and disperse' approach. This did not pose difficulty as habitation was less and land was abundant. Waste was treated by natural processes being a part of natural cycles. This strategy became ineffective and environmentally problematic when people started to congregate in the cities and industry flourished. In the late 1960s and 1970s, a series of toxic chemical waste dumping incidents (Love canal, New York, USA in 1977, Cyanide dumping, Nuneaton, UK in 1972) led to increasing awareness of the importance of waste management and highlighted waste as a potential source of environmental pollution. The increasing concern for the environment and the toxic waste dumping incidents created demand for controlled waste disposal (Williams 1998). The next planned and saved waste disposal approach was 'concentrate and contain'. The environmental reputation of waste disposal through 'concentrate and contain' approach failed to pursue environmental excellence but rather turned the environmentalists view into part of the problem, not the solution (WRI 1989). From around the 1980s, the focus of waste management was on raising technical standards and policy measures for waste disposal and treatment. Since the 1990s, the waste management focus has shifted from the conventional collection and disposal to resource conservation and resource recovery. This sustainable waste management solution lies in considering waste as a resource and developing methods to redirect these resources back into the economy or nature through a cyclic process (Lens et al. 2004).

Several waste management theories have been developed so far for the promotion of waste minimisation, recycling and appropriate disposal. The contributions of waste management theories are 'green economics' of Powell and Brission (1994) and Cooper (1995), 'economic instruments' of Pearce and Turner (1992) and 'minimisation and recycling strategies' of Coggins (1993) and Gandy (1994) (After

Read et al.1997). These theories complement the policy instrument by a 'carrot and stick economic approach' for the promotion of waste prevention and recycling. The economic 'sticks' are the direct user charges and landfill taxes and the economic 'carrots' i.e. incentives, are the grants or subsidies, recycling credits, deposit refund systems, preferential purchase schemes and public education and information dissemination schemes etc. (Wilson 2000 ; Read et al. 1997).

Summary from the section

- Increased environmental concerns and the emphasis on resource recovery are gradually changing the orientation of municipal solid waste management from a 'dispose, dilute and disperse' towards a 'recycle and recovery' approach.

2.5 Urban waste – Problem or Resource?

In simple terms, a material is defined as waste if it is useless at the present moment to someone who disposes of it but a potentially valuable commodity to someone who possesses it (Peavy et al. 1985). Poerbo (1991) finds two different views on urban waste - one considers urban waste as a health and environmental hazard and the other considers it as an economic resource which creates job and income opportunities. Mr. Mostafa Tolba, the former Executive Director of UNDP in his book 'The World Environment 1972-1992: Two decades of Challenge' describes '*Waste is a resource in the wrong place at the wrong time, if used in the right way, waste becomes a resource like any other natural resources*' (p-24). Kaseva and Gupta (1996) agreed with the philosophy of waste and termed waste as a misplaced resource and placed emphasis on tapping it for the benefit of the society. Sigular (1992) distinguishes two types of use of waste, namely waste-as-refuse by waste officials and waste-as-ore by scavengers. Furedy (1992) highlighted the 'waste economies' in Asian cities and viewed waste as a 'survival strategy' for the urban poor. Perla (1997) identified urban wastes as economic goods that contribute to the society by creating job opportunities, enhancing green campaigns and promoting awareness of the potential value of waste. Nowadays solid waste management has been shifting away from disposal towards waste reuse and recovery which Furedy (1992) described as 'resource recognition' i.e. solid waste is not perceived as useless, smelling rubbish but rather as an under-used

resource. It can be transformed into a valuable resource by the enhancement of reuse and recycling. Tandon (1992) pragmatically viewed waste as a resource and emphasised its management and utilisation for the conservation of resources rather than mere disposal.

Lardinois and Klundert (1993) criticised waste as a problem that increases transport and disposal costs and occupies space for disposal, and laid emphasis on the reduction of waste quantities by waste reuse and recovery. Simmonite (1990) explained the benefits of recovery and reduction of waste that leads to smaller quantities of waste requiring disposal, less landfill area, low environmental pollution and low overall cost of the landfill operation. Smit and Nasr (1992) focused on reduction and reuse of waste flows through sustainable resource management. They pointed out that it would be achieved by turning waste materials from a consume-dispose open loop system to a consume-process-reuse closed loop system.

Summary from the section

- Waste is perceived as dirty and a problem while it is unattended but when it is managed properly it can be a valuable resource.
- The philosophy behind the waste is 'waste-as-ore', 'survival strategy' and 'misplaced resource' if it is utilised.
- In sustainable waste management systems waste is not viewed as 'useless rubbish' but a valuable resource for which another use can be found.

Nevertheless, waste is a problem in the developing cities in terms of its management but in this study, waste will be considered as a resource through the process of composting.

2.6 Waste disposal strategy: theories and practices

The waste disposal problem is global with many nations suffering from similar fates, with serious local implications particularly for ground water pollution and methane gas emission. To face the growing problem of waste disposal the developed countries have adopted some strategies and set out policies in relation to recovery and disposal of waste. These are:

- *'Self sufficiency principle'* states that member states of the European Union shall take appropriate measures to establish an integrated and adequate network of disposal installations which enable the union as a whole to become self-sufficient in waste disposal (EC 2000; Williams 1998).
- *'Proximity principle'* recommends that waste should be disposed of (or otherwise managed) close to the point at which it is generated which will reduce time, energy and the expense of long distance transport (Barton et al. 2001).
- *'Polluter pays principle'* implies that all producers of waste are legally and financially responsible for the safe and environmentally sound disposal of the waste they produce (Schubeler 1996).
- *'Making waste work'* is the policy framework of the National Waste Strategy of the UK with the underlying concept of sustainable development:
 - to reduce the amount of waste produced
 - to make the best use of waste
 - to minimise the risks of immediate and future environmental pollution and harm to human health
 - to place the waste management option towards the top of the waste management hierarchy (Williams 1998; Wilson 2000).
- *'Hierarchy of waste management'* is the framework for establishing the order of preference that waste is not merely disposed of , but should, where possible, be recovered, reused or minimised with waste reduction the most preferred and landfill the least preferred options(Barton et al. 2001; Wilson 2000).
- *'Zero waste policy'* is a 100% solution, a whole system approach to resource management that maximises recycling, minimises wastes, reduces consumption and ensures that products are made to be reused, repaired or recycled back into nature or the market place (Earth watch 2001).
- *'Best Practicable Environmental Option'* (BPEO) is the outcome of a systematic and consultative-decision making procedure which can be applied in a wider context to policy and strategy planning for waste disposal and implies that different alternative options are to be investigated before the preferred option is chosen; this being the one which provides the best benefits

or least damage to the environment as a whole, at an acceptable cost in the long-term as well as in the short-term (Barton et al. 2001).

- '*Best Available Techniques Not Entailing Excessive Cost (BATNEEC)*' is linked to the Best Practicable Environmental Option (BPEO) which inevitably leads to the best environmental outcome within affordable cost (Williams 1998; EC 2000).
- '*NIMBY (Not In my Back Yard)*' attitude reflects the resistance of the adjacent residential population for siting a waste disposal and treatment facility. Overcoming the NIMBY attitude requires public understanding of the requirements of waste management, effective communication and participation of the concerned community in siting decisions (Schubeler 1996).
- '*Landfill Directive*' of EU member countries places strict limits on the amount of bio-degradable municipal waste to be disposed of and implies the diversion of these wastes towards appropriate treatment options (Nolan 2002).
- '*Landfill tax*' is the tipping fee imposed for the facilitation of reduction of landfilling bio-degradable wastes (Wilson 2000).

Common problems for solid waste management in developing countries include institutional deficiencies, inadequate legislation and resource constraints (UMP 1999). National policies are now being formulated in several countries, but lack of effective enforcement of environmental regulations is a major problem. Although there are waste reduction and recycling activities promoted by communities, NGOs and the private sector out of concerns of public health and sanitation, these are informal and are not supported by the municipal authorities (Bulle 1999). Some of the waste disposal strategies of the developed countries may be applicable for the developing countries but are not incorporated or practised due to lack of vision, poor government policy, lack of political will and lack of good system management (McDougall and Fonteyne 2000).

Summary from the section

- The motivation behind the bio-degradable waste diversion in developed countries is attributed to the stringent regulatory framework of waste disposal and economic instrument like imposition of landfill tax.

- The developing country initiatives are based on local level solutions and community participation. There is no adequate legislative and regulatory framework to control the waste management activities.
- Some of the learning from the waste management principles is universal and effective for waste reduction and recycling. It encourages the public to think about the creation of waste and take responsibility for what happens to it.
 - Every community should be self-sufficient in waste disposal and management (Self-sufficiency principle).
 - Every community should recycle or dispose of the waste it produces inside its own territorial limits (Proximity principle).
 - The desire to reduce or recycle waste at sustainable economies (BPEO and BATNEEC)

2.7 Community participation

Community participation is a process in which community is a beneficiary and Community Based Organisations (CBOs), NGOs, Local Government and other stakeholders are the facilitators who work for the benefit of the community. A community is a group living in a certain geographical or administrative area encircled by a neighbourhood, which has access to and use of the same service (Anschutz 1996). This does not mean that they are the appropriate unit of homogeneity with the same priorities and concerns. They may have different opinions, interests or conflicts as they are of different social divide, of gender, wealth, age, origins, caste etc. (Leach et al. 1997). But, for the basic service demand, the community acts as a cluster or group force.

A community is a local force, the basic unit for organising development activities. Community participation generally indicates the involvement or representation of the community members. When sustainability of the projects is of concern, community management can be interchangeably used with community participation which refers to local responsibility for operation and maintenance of services (McCommon et al. 1990).

Community participation is the involvement of the community in varying degrees of activities from contribution of cash and labour to consultation, adaptation of

behaviour to involvement in project management and decision making activity (Anschutz 1996). Moningka (2000) gave a direction to the sustainability of a community-based project by defining community participation as *'a process in which community members are involved at different stages and degrees of intensity in the project cycle with an objective to build capacity of the community to maintain services created during the project after the facilitating organisations have left'*. McCommon et al. (1990) considered responsibility (ownership), decision making authority and control over project development as key to any community-based project, which can be achieved by:

- sharing project cost
- assisting in project planning and implementation
- building capacity
- increasing community empowerment

The community workers' co-operatives of Ireland (1997) gave a clear distinction about community participation:

Community participation is	Community participation is not.....
√ a process which empowers people to take an active part in decision making.	× only to give information
√ a process which enables people to develop skill, knowledge and confidence.	× a process which decides what is good for people
√ active involvement of people	× asking people what they think
√ a process which requires commitment of resources and some dedication of time, effort and energy.	× a process which provides no resources of any kind, communal or financial.

Community participation is an effort of voluntary nature. It can be in the form of labour input or financial contribution with no corresponding transfer of authority or decision making power. In the other form a community can be enabled to take control of the operation and administration of the system completely. Table (2.1) shows different types of participation of the community.

Interactive participation	Community participation in response to local people's demand for external agency initiated project. Participation is seen here as citizen's right.
Participation by Consultation	Community involvement in the form of consultation or by answering questions.
Participation for material incentives	Community participation by mobilising through incentives.
Passive participation	Community participates by being told what has been decided or has already happened. Community can hardly play any role.
Functional participation	Community participation as a means to achieve predetermined project goals.
Self- mobilisation	Community participation by independently taking the initiative to change the system. Community initiates projects and then they request external agencies to implement it.

(Source: UN (HABITAT) 1996)

Perceptions about community participation have been changing gradually. Community participation is now becoming a proactive process in which the beneficiaries influence the development and management of the projects rather than merely receive the project benefits. In the past, the conception of community participation was largely confined to labour and material contribution. However, the proactive views emphasising the beneficiaries' participation in the decision making process, taking charge and influencing and controlling the project activities (Narayan 1995). Narayan (1995) and Wright (1997) pointed to some key indicators for the sustainability of community participated and managed projects:

- Community participation in the decision making - All aspects related to project development and implementations have to be based on community preferences. The community has to communicate their needs, fix their priorities and decide their participation and contribution in the project process.
- Informed choice- Community must be provided with the necessary information to understand the options, available alternatives and associated costs to make rational and socially optimal decisions.
- Community contribution- Community may be willing to contribute to development and operation of the project in the form of money, material, labour or by participation in project related committees and meetings. The contribution must be within the affordable limit of the community. The projects are unlikely to be sustainable if the resources required for

operation and management are beyond the capacity of the community to provide.

- Representation – Community members who act as representatives should be democratically elected or selected in a consensus way. The leadership should be dynamic and should have capacity to mobilize the community to lobby for assistance from the government.
- Responsibility - Community needs to assume the responsibility for the project through realising that its survival or collapse depends on their investment in terms of time, physical and financial capital. Roles of each stakeholder need to be clearly defined to avoid confusion in expectation or trust among the community members.
- Authority or Ownership – Community has to have the authority to make decisions relating to the project where the intervention from external agencies (e.g. donors, government) should be minimised. Although the formal legal ownership or authority of the project is highly desirable for the sustained operation of the project, it may not always be possible in the existing legal frameworks. However, the community should perceive the importance of ownership.
- Control – Community must have direct or indirect control over the operation and management of the project. The community should be empowered to make decisions on the project design for its long-term operation and management.

Moningka (2000) added some factors favourable to sustainability of the community projects:

- Awareness-raising is vital to make the community members appraised of the project activities and to stimulate them about their participation. An intensive and extensive information, education and communication (IEC) campaign must be conducted before and during the project implementation. In this way, the community members will feel responsible for the service and its continuity.
- Support and recognition of local authorities is imperative in community based projects. The local authorities have to transport and dispose of the waste collected by the CBOs/enterprises. The recognition of the CBOs

activities by the local authority gives them the authority to collect fees and protects them from political interferences. Although recognition and support of the local authority is important, the absence of a legal framework inhibits the local authority from supporting the community initiatives (Bulle 1999). Formal agreements between the CBOs/micro-enterprises and the local authority based on a clear division of responsibility and mutual commitment are essential for resolving the legitimacy conflicts and smooth functioning of the project.

- Financial and operational viability are necessary for the continuation of the project. Financial viability depends on contribution of fees from the community. This will make the community based services less dependent on external support. Operational viability may be obtained by optimum utilisation of manpower and resources.

McCommon et al. (1990) presented the levels of community participation and management in a tabular form, from where the project status can be predicted (Table 2.2).

Level	Responsibility	Authority	Control	Management capacity	Project status
I	External agency; little community responsibility	External agency; informal community consultations	External agency; limited community participation	Insufficient	Not sustainable and replicable
II	External agency; community responsible for operation	External agency; limited formal role for community institutions	External agency; moderate community participation	Limited	Not sustainable and replicable
III	Joint; community responsible for operation and maintenance	Joint; collaborative role for community and agency	Joint; strong community participation and limited community management	Moderate	May be sustainable and replicable
IV	Community; external support	Community; external support	Community; external support	Sufficient	Sustainable and replicable
V	Full community responsibility	Full community authority	Full community control	High	Sustainable but not replicable everywhere

Summary of the section

- The water and sanitation literature is used to provide a theoretical framework for defining community participation in solid waste management. Community participation in solid waste management is relatively new, while water supply projects have a long history of community participation and management. For sustainability issues of the community-based solid waste management projects, 'community management' can be used interchangeably with 'community participation' and the sustainability indicators can be selected accordingly from the water and sanitation literature.
- Community participation can be in two forms. One is by providing labour input or financial contribution with no authority or decision making power. The other form is to take control of the operation and administration of the project.
- Community awareness raising and capacity building, community contribution, authority and ownership, community control and management may be the indicators for sustainability and replication of community-based projects.

2.8 Community participation in Solid Waste Management

The community generates waste, so the community has a role to play in the solid waste management process. Community members may receive a waste management service as beneficiaries in the context of residents, service users or tax payers. Bulle (1999) classified different degrees of community participation in solid waste management:

- Individual participation - At the individual level, residents can be involved in keeping waste in a proper way in a bag or bin, practising waste separation, putting waste in the right place at the right time for collection.
- Collective participation - Community members can be collectively responsible for organised activities such as a cleanliness campaign, awareness raising activities or simply meeting with fellow community members and local authorities.
- Material or financial contribution – Community members can participate by donating material (container, van), by physical contribution (working as van

operator, fee collector) or by financial contribution (paying fees for waste collection).

- Participation in formulating projects – Community members can participate in meetings, express opinions and ideas about the project objectives and activities.
- Participation in project management – By becoming members of the committee, they can participate in decision making activities and control the project activities.

Iyer (2001) studied a community-based waste collection project in India and found three basic levels of community participation. At the most basic level, the daily action is the handing over of separated waste at a particular time to the waste collectors. Next the payment of service charges for waste collection. At the end of the spectrum the community can participate in a waste management committee that plans and manages the programme.

Jayaratne (1996) in reporting the case study of Colombo, Sri Lanka reiterates that community participation is an instrument for efficient execution of projects by increasing local resource mobilisation and effective participation.

In the city of Hyderabad, India, Sisodia (2000) and Galab et al. (2004) reported three types of community participation in successful solid waste management activities:

- The community acted as supervisor of the activities of the contractors who were engaged by the municipality. The community was empowered to provide a performance certificate on the contractor's activity (Box 2.2).

Box 2.2: Community as a supervisor of waste management

The community, as the biggest stakeholder in the solid waste management, supervises and monitors the activities of the persons responsible for primary and secondary waste collection. Municipal Corporation of Hyderabad formed 'Local level committees' of residents and empowered them to oversee the performance of the contractors. The contractors had to approach the committee members for their comments / signatures in the daily performance monitoring chart which they used to produce for clearing the bills from the corporation. If any complaint was received from the residents, a fine was imposed on the concerned contractor.

- The community acted as a direct partner on a cost-sharing basis with the municipality for street sweeping, waste collection and vermi-composting. The

community engaged the workers who were accountable to them for their activities (Box 2.3).

Box 2.3: Community as a direct partner of waste management

Several community initiatives had been launched for involvement in the process of primary and secondary collection as well as processing of the municipal solid waste. These initiatives were ranging from sweeping and waste collection in the locality to processing of waste through vermi-composting. Two schemes were launched with community participation and were proved successful- one was 'Voluntary Sweeping Scheme' (VSS) and the other was 'Voluntary Garbage Disposal Scheme' (VGDS). The scheme fixed a partnership on 50-50 cost sharing basis. The residents were authorized to engage the required number of sweepers for maintaining their own service. The workers were engaged by the community association and were fully accountable and answerable to the association and thus the quality of sweeping and collection was better than in other areas. Ensuring the concept of the 'Zero Garbage Colony', the community association had started vermi-composting of the garbage and utilised the compost in their gardens and lawns. These initiatives had been proved successful and replicated in other areas as well.

- Rather than performing the role of mere supervisors over the contractors, the Residents Welfare Associations, NGOs and Women's Groups were encouraged to take the contracts for the operation of sweeping and garbage collection and the performance was much better than that of the regular contractors.

In Kenya and Angola, two community-based solid waste management projects were outstanding examples of an extremely high degree of community participation (Box 2.4). The initiatives for solid waste management came from the community and were both for managing the waste problem of the community by reusing waste into an economic activity. The technologies used for waste removal were developed locally and were low cost.

Box 2.4 Community-based solid waste management in low income areas of

Kenya and Angola

Community-based solid waste management project in Nairobi, Kenya

In Kenya, women's groups in low income settlements were involved in composting of organic waste. The waste was collected from the area and was sorted into organic and inorganic. The organic waste was further sorted to remove foreign objects. After that it was piled for composting in a site near the settlement. Once the compost was ready, it was sieved and put in bags for sale.

Community-based solid waste pilot project in Luanda, Angola

Development workshop (a local NGO) implemented a pilot initiative to separate sand from other household waste generated. Residents were taught that sand was not a waste but a useful commodity. The sand recovered from the waste was reused as infill material to improve the roadways within the community by a food for work programme.

(Source: HEC-PRECEUP 1998)

Summary from the section

- The community can participate in various capacities in solid waste management from individual to collective effort, from contribution to project formulation and management.
- The community can also participate or co-ordinate the municipal solid waste management activities as supervisor or as direct partner or as contractor.
- If the project initiatives come from the community, the community can grow a strong sense of belonging, local residents can get trust and be willing to support or even join the project activity.

Community based organisations (CBOs), Non governmental organisations (NGOs) and private enterprises are now becoming major players in the waste management sector. It is increasingly recognised that the majority of community-based projects are unable to manage without some form of external assistance. Government, NGOs, CBOs in combination or in collaboration can establish a community management waste model in a participatory manner (Gozun and Palomata 2000).

2.9 Various actors and their collaboration in community-based solid waste management

Various actors in different capacities are concerned with municipal solid waste management as service users, service providers, intermediaries and/or regulators. Their interests and roles in community-based solid waste management are described below:

Community Based Organisations (CBOs) are informal institutions that formed by the members of a community, especially from the middle and high-income areas, for the purpose of improving the waste situation in their neighbourhood. CBOs have important roles to play not only as consumers or users of waste collection services but as providers and/or managers of local level services. The social service motive is the main driving force of the CBOs. They have considerable potential for managing and financing local waste collection services. Some CBOs are organised and formed to improve local security, environmental quality, basic utility and social service (Schubeler 1996) and extend their programme to waste collection. Some CBOs have

evolved only for the neighbourhood waste collection services. They are involved in various activities from hiring (formal or informal) waste collectors, collecting fees for waste removal, practising waste separation, making arrangements with local political leaders for waste transfer points and promoting reuse and recycling of materials (Klundert and Lardinois 1995).

Sustainability of this type of initiative depends on the participation of the community.

Non- Government Organisations (NGOs) main functions include awareness raising, advocating community interests, consulting and providing capacity building support to community-based development, mediating between communities and government authorities, and occasionally managing project activities (Schubeler 1996). They serve the ideological, political or altruistic interests of international organisations and act as partner organizations with the CBOs to provide a channel for donor finance (Klundert and Lardinois 1995). They act as a voice for the community and as a parallel provider of public services (Lockwood 2004). NGOs work for solid waste management related activities from social and environmental concerns.

Sustainability of NGO initiated activities depends on a source of external funding.

Community Leaders are the champions of the community-based initiatives. Community leadership is very important to participatory programmes. Local leaders can be divided into traditional or ethnic, formal or informal categories. Traditional leaders derive their authority from hereditary rights, formal leaders are appointed by the government or elected as local representatives, and informal leaders are the influential members of a community on the basis of personal status, link with political powers or as familiar social workers in the community (Anschutz 1996). Their roles as local leaders are to encourage people to subscribe for waste collection, to make sure that people pay their fees, to stimulate the separation of waste and to monitor the performance of the service. Furthermore, they act as a negotiator for local authorities, supervise the performance of local authorities and private enterprises, and act as a pressure group to obtain services from the local authorities (Moningka 2000).

Women are the managers of households and thereby they are responsible for cleanliness within and around the home and for taking care of waste. *'Women are responsible for handling the unhealthy situations on a domestic level and thus they are endowed with a sense of civic responsibility and a desire to improve their living conditions'* (Bulle 1999).

Micro-enterprises are registered organisations that usually provide capital and management support to small-scale development activities. They are primarily interested in earning a return on their investment in community-based solid waste collection and recycling activities (Anschutz 1996). They undertake activities of a general interest with the support of public bodies (donors, NGOs, local authorities). In the trends towards decentralisation, they organise themselves so as to be able to tender for public contracts and to receive project management. Although they are legally registered companies, albeit in most cases with limited financial means, they may be viewed as belonging to the local, or even the informal economy (Bulle 1999).

They are the economic interest groups and their activities are profit oriented and with potential for sustainability.

Local authorities can act as a service provider or facilitator to support the community-based solid waste management. The interests of local government authorities are political and legal. The local authorities cannot always promote or actively support the communities, as there is no legislative or legal framework to supervise or take part in community initiatives or they do not always have the technical or financial means to support the activities (Bulle 1999).

Informal private sectors comprise unregistered and unregulated activities of informal sector workers. The basic motivation is self-organised revenue generation driven by poverty. The informal waste workers belong to religious, caste or ethnic minorities or the socially disadvantaged. Sometimes they work individually or form co-operatives for waste collection and recycling activities. They reduce a significant amount of the waste stream by scavenging through wastes for their livelihoods (Medina 2000).

External support agencies are bilateral and multilateral groups or sometimes the NGOs engaged in supporting municipal solid waste management in low-income countries. They support community waste management within their broad development programme aimed at urban environmental improvement (Schubeler 1996).

Community-based activities have played a significant role in the delivery of waste management services. In the present institutional structure keeping the public places clean is assigned to the municipal authorities. However, due to irregular and inefficient service of the municipal authorities, the community-based organisations, non-governmental organisations and private groups (formal and informal) have

extended their support to local solid waste management services. Much interaction or close linkage in the form of partnership between these two sectors, public and community or private, with or without the support of a facilitating organisation, has been established to improve the service efficiency (Ahmed 2004). In solid waste management, various partnership efforts may be formed to improve the waste situation in the community.

NGOs-CBOs combined efforts

Community-based solid waste management activities can be managed by the combined efforts of Non-government organisations (NGOs) and Community-Based Organisations (CBOs). In this type of partnership modality, the NGOs' participation is facilitating and the CBOs' activity is project management. NGOs usually initiate the project and together with the CBOs operate and manage the service. The NGOs' role is overall supervision, technical and financial assistance, training and capacity building support, recruitment of management committee members and operators. The CBOs' role is operation and management of waste collection activities. This example can be seen in Chad and Ivory Coast (Anschutz 1996).

Local Government institution co-operating with CBOs

In this organisational structure, operation and management of the service are carried out by CBOs, either motivated by the generation of income or for a clean environment. Local government authorities extend their support by providing material and financial resources. This example can be seen in Padang, Indonesia (Anschutz 1996).

Micro-enterprises and CBOs working together

In this modality of partnership, CBOs are responsible for project management and supervision, while the micro-enterprises are responsible for project operation. The CBOs motivation is towards a clean neighbourhood while the micro-enterprises work focuses on income generation. This organizational structure is working in Bamako, Mali (Anschutz 1996).

Summary of the section

A wide range of individuals, groups and organisations are working with varying capacities in community waste management. They work as service users, service providers, intermediaries and/or regulators. The joint effort of the actors in different

collaborative arrangements can be a sustainable approach towards the community waste solution.

2.10 Community attitude in solid waste management

Attitude and motivation of the community residents can refer to community participation in source-separation. Source-separation is an environmentally and technically better way to improve the quality of compost (Dulac 2001). In an experimental project in Cairo, Egypt, 600 households separating the organic and non-organic fractions of wastes realised the benefits of source-separation (Lardinois and Klundert 1993). These include:

- getting higher selling price of cleaner recyclable materials
- requiring less time for sorting out waste materials in the compost facility and
- improving compost quality

Source-separation essentially demands the individual household's willingness to participation in separate waste collection systems. Chung and Poon (1999) noticed in Hong Kong that the majority of people were willing to separate materials that are easy to separate and sell, such as newspaper, metal, cans and plastic bottles. But they showed low interest in separating wet waste due to the absence of direct benefits from it. Noor (1996) reported that low-income groups are willing to carry out source-separation in order to earn money from waste materials.

Gupta et al. (1998) reported that source-separation requires attitudinal changes from the people. The residents need to be sensitised and educated about the need and advantages of doing separation. Noor (1996) conceived the same idea that source-separation requires a change of behaviour which needs a variety of factors including literacy or public education. In a pilot project in the Argentinian village of Villa Giardino, it was found that through an intensive awareness raising campaign the inhabitants were convinced of the benefits of organic and inorganic waste separation and the level of contamination of compost was found to be only 0.5% (Seifert 1992). Nas and Jaffe (2004) argued that public education and awareness raising campaigns have not till now proven successful in changing people's behaviour regarding waste management. The residents may appreciate and agree the concept of source-separation but this work is always left to the servants in the Asian countries (Furedy

1992). The maid servants may be unwilling to co-operate with source-separation without having any incentives for it and they may consider it extra work for them (Anschutz 1996).

Furedy and Whitney (1997) noted a dismal picture of pilot source-separation schemes in Asia failing due to inadequate household co-operation. The people were not receptive to the cultural practice of source-separation (Kaseva and Gupta 1996). Dulac (2001) emphasised the importance of a communication strategy to inform people about which materials will be sorted out and how they will be sorted. Whether source-separation is mandatory or voluntary, the waste generators have to be educated on procedures (Pieters 1991).

Some incentives or disincentives have to be imposed into the scheme. Under an organised system, source-separation is mandated by law with penalties for non-cooperation such as fines or suspension of collection services. Economic benefits have more influence on proper behaviour of household level separation.

- In the Philippines, an NGO of Women's organisation tried to encourage housemaids to do source-separation by giving them the proceeds of the sales of recyclable materials (Lapid et al.1996).
- In Curitiba, Brazil an incentive of free bus tickets and food vouchers was provided in exchange for garbage in the Green Exchange Programme (Lardinois and Klundert 1993).
- In SIDRO recycling project in Mexico, women who were involved in source-separation received a discount when they bought vegetables produced from bio-fertilisers made of their wastes (Anschutz 1996).
- In Argentina, an incentive of one kg compost was given to the households who were participating in source-separation (Lardinois and Furedy 1999).
- Women's group in Kathmandu, Nepal provided households with buckets and promised a cash prize for the cleanest house and immediate environment (Dhungal 1992).

Despite the willingness to do source-separation, it is somehow affected by social and religious barriers.

- In South Asia people considered wet organic waste as polluting and a job for people who were born to do such filthy work (Beale 1997).

- Orthodox Muslim and Hindu religion people feel themselves to be impure if they touch waste (Medina 2000).

Summary from the section

Source-separation relates to the attitude of the community. It may be mandatory or voluntary but it can be instigated by community awareness and motivation, willingness to participate, incentives or disincentives and convenience of separating waste.

2.11 Local Government participation in community waste management

Local government authorities are generally responsible for the provision of solid waste collection and disposal services. They are the legal owners of the waste once it is collected or disposed of for collection. They are mandated to provide waste management services by the central government with an allocation of budgets. In order to implement their statutory obligations the local government authority formulates laws and regulations. Beside, their legal obligations, the local government authorities are normally motivated by political concerns to provide solid waste services.

The local authorities of the developing countries are lacking in both financial and institutional capacities to provide efficient solid waste management services (Schubeler 1996). It is recognised that the municipalities, the private sector and the community all alone can unable to improve the waste situation on their own. They need a collaborative effort. Ahmed (2004) emphasised the partnership between the CBOs and the local authority for sustaining the waste collection services. The local government may take a leading role to institutionalise the informal community-based initiatives within their formal waste management services. The local authority can assist community-based solid waste management services by providing the facility support, by formulating favourable policy/legislation, by providing financial assistance or by organising promotional activities.

- In Quito, Ecuador, the municipality stimulates a neighbourhood sorting and recycling plant by selling its recyclables (Anschutz 1996).

- In India, Bangalore City Corporation gave institutional support and official recognition to a local NGO Centre for Environmental Education (CEE) who was engaged in primary waste collection and composting activities (Iyer 2001).
- The Zabbaleen in Cairo were successfully running waste collection, recycling and composting business as they got the formal recognition of their services from the government which encouraged them to organise activities (Anschutz 1996).
- In India, Jaipur Municipal Corporation supported 'Clean Jaipur Project' by providing land and initial financial support to the NGO (Centre for Development Communication) which was operating waste collection and composting activity (UNDP-World Bank 1999).

On the other hand, the local authority can obstruct community-based solid waste activities either directly by hampering the performance or indirectly by refusing legal, financial or promotional support. The lack of coordination in the interface between the primary and secondary collection system is a most common example. The parallel collection of waste from the community by the local government authority, ignoring the activities of the community initiated project, is also an example of non-cooperation.

- In Ivory Coast, Abidjan, a COPRICOL project had to stop its activities because the local municipality introduced a compactor truck for waste collection from the community (Anschutz 1996).
- In Lucknow, India a local NGO Muskan Jyoti Saniti (MJS) got support (land, capital and equipment) from the state government. But it did not get support from Lucknow Municipal Corporation which saw the NGO initiative as a threat to the municipal activities (WSP-World Bank 1999).

A politically motivated or influenced project is very temporary. Any political change may discontinue any previous agreement or support. Interference from politicians is also a major impediment to carrying out community-based projects.

- In Mali, Bamako the municipality told the micro-enterprise GIE Beseya to pay for the land, which it got free of charge from the earlier municipal mayor for waste sorting and composting activities (Lardinois and Klundert 1993).

- The SIDRO project in Mexico faced a problem with government support because the government feared that CBO activities in empowering the poor people would undermine its political image (Lardinois and Klundert 1993)
- In Kathmandu, Nepal a GTZ project stopped in 1990 because of political problems (Furedy 1992).
- The expansion and replication of the municipal sweeper system in Karachi, Pakistan was stopped because of municipal unwillingness (Ali and Saywell 1995).

The public representatives such as ward commissioners are important in local government institutions. The positive role of the politicians is also a success factor for the community-based solid waste activities.

- In Sao Paulo and Curitiba, Brazil, the progressive mayors played an important role in improving the living conditions and waste management services in the neighbourhoods (Lardinois and Klundert 1995; Rabinovitch 1992).

Incorporating community-based solid waste collection and recycling in policy and legislation is very important to guide and oblige households to separate their waste at source and deliver waste at a fixed place and at a fixed time. Provision of fees and laws for prohibiting littering can make people disciplined and improve the neighbourhood environment.

- The Ecological Waste Management Act of the Philippines (2001) emphasises community-based solutions to solid waste problems and stresses the empowerment and participation of local communities in environmental decision making.
- The policy support from MMDA (Metro Manila Development Authority) helped the Women's Balikatan Movement in waste management. It involved more than 18000 households in source-separation, local government authority in daily collection of wet waste and Eco-aides to buy the dry waste (CAPS 1991).
- The National Environmental Policy (NEP) 2004 of India specifies that municipal authorities should organise programmes so as to ensure community participation.

Summary from the section

- Local government support and acknowledgement of the community activity is imperative.
- Recognition of community activity by the local government can increase public trust on the organisation.
- Municipal officials are more inclined to preserve the traditional role of the local authority in waste collection and disposal. They find NGOs/CBOs activity as a threat which may undermine their image or threaten their jobs.

2.12 Composting for waste management

Inadequate management and disposal of municipal solid waste is an obvious cause for environmental degradation and health risks. The selection of the appropriate option may be subjective. The decisions about the preferable option must be taken on technical, social, economic, environmental and political factors (Williams 1998). Many developing countries have tended to look to the industrialised countries for waste management technologies, but technologies developed for use in the developed countries are often hard to transfer successfully to the developing countries due to wide differences in the climate, the nature of the waste streams, the pattern of urban settlement and prevailing socio-economic conditions (Sundaravadivel et al. 2000; WRI 1989). Poerbo (1991) defined the guiding principle for an effective and efficient waste management system for the developing countries, which removes wastes economically with low investment costs, which is socially and politically acceptable, and which is sustainable in terms of financing its own operation.

Composting is the controlled biological decomposition and stabilisation process of organic substrates which allows development of thermophilic organisms to create biologically produced heat, with a final product sufficiently stable for storage and application to land without adverse environmental impact (Haug 1980). From the definition, the following objectives of composting are outlined:

- It can biologically transform putrid organic material into a stabilised product
- It destroys the pathogenic organisms by elevated temperatures and presents a safe product
- If compost is used, it can accomplish the following purposes:

- To serve as a source of organic matter for maintaining or building supplies of soil humus, improving proper soil structure and moisture holding capacity.
 - To replenish and reuse certain valuable nutrients including Nitrogen, Phosphorus and Potassium and a wide variety of essential micro-nutrients and trace elements; and
 - To enhance the growth and yield of crops
- In the waste management sector, composting imparts the following benefits:
- Minimizes environmental hazards of disposal.
 - Reduces waste transportation and disposal costs.
 - Saves landfill space.

2.12.1 Historical development of composting

Composting is an indigenous method that has been practised all over the world with various levels of scientific and technical innovations. The historical review of composting is well documented by Rabbani et al. (1983) in Environmental Sanitation Reviews.

Pre-1940 period

Composting was developed as a fine art in China in 500 BC. European farmers were the first to use organic wastes for maintaining soil fertility (EC 2000). However, composting of municipal waste as a waste reduction technique or as a product for soil improvement did not develop until the 1920s in Europe. The development of a systematic approach to composting began with British economic botanist Sir Albert Howard's work on the Indore system in the early 1930s in India.

1940- Early 1960 period

In the 1940s and the early 1950s extensive research had started to develop the scientific principles of composting in New Zealand, University of California USA and in UK. The new research was directed towards the complicated mechanisation process. The University of California Windrow process, the Dano process, the Naturized system and the V.A.M process of Holland were developed in response to the need for controlled and hygienic disposal practices by enclosed and speeded-up processes. It was high-tech and expensive.

Mid-1960 period

In the mid 1960s, interest in composting grew substantially due to the public concern for the environment, but the backdrop of financial failures once again discouraged the composting processes.

Late 1960s to the present

In the late 1960s, the monetary sense gradually faded and composting had regained priority for protecting the quality of environment and bringing social benefits. The recent upsurge of interest in composting has been largely as a result of increasing pressures on landfills and the restrictions on organic waste disposal. Large-scale centralised composting plants had been established in Europe to meet the target to recycle or compost 25 percent of household waste by 2005 (Williams 1998). Small-scale individual household composting has been practised for many years as a traditional gardening culture of the UK.

In the 1970s, most of the city governments in Asia and Africa imported sophisticated and highly mechanised composting plants, but most of the plants failed due to technical and operational difficulties, and high operational and maintenance cost (Hart and Plumiers 1996; UNEP 1996; Asomani-Boateng and Haight 1996). Following the failure of municipal experiments with mechanical composting plants, most local governments showed little interest in promoting composting. Some commercial undertakings started up in the 1990s (Excel Industries in Mumbai, KCDC in Bangalore, India). At the same time some small-scale composting projects were initiated by the NGOs and communities (Waste Wise, Clean Environs, CEE etc.) for experimentation or decentralised waste solutions. The UWEP (Urban Waste Expertise Programme) funded by the Netherlands government experimented with a large number of small-scale composting projects in some cities of Asia and Africa (Klundert and Lardinois 1995). Recent policy in India 'Waste management and handling rules 2000' mandated composting as part of the solid waste management in larger cities and has opened the way for a large number of flourishing composting activities.

Summary from the section

Small-scale community-based composting facilities are more appropriate in the developing countries as a decentralised waste solution. Some small-scale composting activities are growing up for experimentation or decentralised waste solutions.

2.12.2 Key features of community-based composting

From the literature on composting (Zurbrugg and Drescher 2002; Perla 1997; UNEP1996) community-based composting projects can be defined by:

- Small-scale of operation with low capital investment.
- Labour-intensive technology for local employment creation.
- Combined with primary waste collection scheme for effective labour utilisation and cross-subsidisation of composting cost.
- Sited close to the point of waste generation in conformity with the community.

The benefits of community-based composting projects are (Perla 1997; Zurbrugg and Drescher 2002):

- Low capital investment; requires minimal equipment and infra-structure.
- Flexible in operation and management; can be easily scaled to meet the demand.
- Relatively simple to learn and implement.
- Enhance environmental awareness in the community.
- Create employment in the neighbourhood.
- Better adapted to the specific socio-economic condition.
- Reduce waste management costs of the municipality by managing waste near the point of generation.
- Complement the waste collection system by processing waste within the community.

The potential drawbacks of community-based composting are (Allison et al. 1998):

- Relatively high open space requirement.
- Limitation of marketing the product as the community organisations does not have marketing knowledge and experience.
- Difficulties in securing finances from the community for the composting operation.

- Land is a major constraint in urban areas for composting in terms of its siting and availability.

2.13 Financial aspects of composting

Until recently the traditional cost accounting system has been followed in the solid waste sector; this does not reflect the actual costs as well as the benefits of the system. In general, the policy makers demand a waste management system which can manage waste at the least possible cost with due regard to safeguarding the environment (Turner and Powell 1991). The selection of the waste disposal facilities in the developed countries is governed by the BPEO (Best Practical Environmental Option) and BATNEEC (Best Available Technology Not Entailing Excessive Cost) principles which are based on financial costs and revenues, as well as environmental and social factors (Williams 1998; Powell 1996). The developing countries are not exceptional in making decisions merely on the basis of a traditional cost accounting system. The social and environmental impacts, both positive and negative, are to be considered in the appraisal process but these effects (improved health, income generation, reduced odour and nuisance etc.) are difficult to quantify.

The significant volume reductions associated with composting and the possible uses of waste can make municipal solid waste composting attractive. Reduction of transportation and disposal costs, landfill space savings and reduction of environmental impacts of disposal sites are the financial savings of the municipalities. To make it simpler, the composting process can be assessed by investment and operational cost, cost recovery, market opportunity or commercial viability and cost reduction (Schubeler 1996). Composting has a poor reputation in terms of cost recovery (Diaz et al. 1996). When the overheads, indirect and hidden costs as well as the benefits, are considered in the cost accounting system, then composting may be found to be relatively competitive with landfill.

The true reflection of costs and benefits can be measured by a full cost accounting (FCA) system. Full cost accounting generally refers to the accounting process of systematically collecting and presenting costs as well as benefits (EPA 1997). It supports three goals: (i) Information goals- by determining and reporting every cost (ii) Management goals- by identifying potential savings and proving a sound basis for

management decisions and (iii) Planning goals- by documenting information and cost figures for evaluation and future decisions. Full cost accounting can be distinguished from the traditional cost accounting system by the following basic principles:

- Accounting for depreciation costs: Purchase costs are allocated over a period of time because every year of its use contributes to the depreciation value.
- Accounting for hidden costs: Hidden costs are the donations or grant money as included initial investment costs. Though the community is not paying for it but the value is recorded in an FCA analysis for objective comparison.
- Accounting for overheads and indirect costs: Overhead costs are the management and administrative costs (rent, office equipment, utilities etc.) to run the facilities and indirect costs are the public education, community mobilisation costs.
- Accounting for past and future outlays: Past and future outlays often do not appear in annual budgets under traditional accounting systems. Past outlays are initial investment costs necessary to implement projects such as the purchase of equipment and facility construction. Future outlays are follow-up costs incurred after the project closure.

Summary of the section

Traditional cost accounting systems usually do not include the hidden or indirect costs therefore do not reflect the actual financial status of the project. In a full accounting system, all the true costs and benefits of solid waste management service can be identified and recorded systematically.

2.14 Compost Demand

The challenge of developing a composting plant is to assess and create demand for the product because compost has no established market value (Diaz et al. 1993). The utility of compost as a soil conditioner has long been recognised. Before the invention of artificial fertilisers, farmers were mainly dependent on organic manures, derived from animal excrement and decayed vegetables, for the maintenance of soil fertility. The greatest benefit of compost is the replenishment of the lost organic matter in the soil. It incorporates humus substances into soil, improves soil texture, water retention

and aeration capacity (Dalzell et al. 1979). Compost also contains macro and micro nutrients which are helpful for plant growth and yield.

Composting has been practised in the rural areas of Asia for centuries (Dulac 2001). Farmers traditionally put agricultural and animal waste on their crop lands. Urban and peri-urban farmers in India had access to relatively uncontaminated urban solid waste sources which were mostly mined from garbage dumps (Nunan 2000; Coad 1996). But the increasing contamination of city solid wastes with urban development and management has led to a decline in organic waste reuse (Furedy and Kulkarni 2004). The following literature indicated that organic waste had demand from the urban and rural farmers:

- Compost had a high demand in Mumbai (India); Beijing (China); Yangon (Myanmar); Ho Chi Minh (Vietnam). The farmers were mining organic matter from the dumpsites (UNEP 1996; Nunan 2000; Brook and Davila 2000).
- In East Calcutta, the municipal corporation leased out mature dump land for cultivation (Furedy 1990; Coad 1997).
- In Nairobi, Kenya the farmers were generally aware of the potential benefits of using compost for soil fertilisers and they intensively used organic manures for long term soil fertility (Allison et al. 1998).
- In Berlin, farmers who brought their products into the city had to carry waste back for applying into lands (Hart and Plummers 1996).
- In Kano, Nigeria mixed solid waste was transported to agricultural farms (Lewcock 1995)
- In Ghana, municipal sewage trucks dumped their waste on farmers' field in exchange for money (Allison et al. 1998)
- In Senegal farmers loaded up donkey carts with untreated household rubbish from the town and spread it on their lands (Allison et al. 1998).
- In Alexandria, Egypt farmers had to wait for two years to receive compost due to its high demand (Yhdego 1993).
- In India, on-farm co-composting of urban animal and farm wastes was practised (Nunan 2000)

Theoretically, there is an unlimited demand for compost for depleted agricultural lands. The organic matter depletion can be replenished with the organic wastes recycled back into the soil. However, there are some general observations on compost

use. The limiting factors for the wider production and application of compost included GTZ (1999):

- Compost is relatively expensive
- Production and distribution costs of waste derived compost are higher than the other locally produced organic manures.
- Poultry litter, cow dung and other organic fertiliser sources are easily accessible to the farmers.
- Artificial fertiliser market is well established and subsidised by the government.
 - Compost exhibits negative stigma
- Organic waste is considered dirty. Cultural and religious factors are a hindrance to compost use and application.
- Product quality varies with the heterogeneous and mixed waste sources.
 - Compost is difficult to transport, store and apply
- Compost is bulky and costly to transport. Transport and other external costs associated with the use of compost, making it unattractive to farmers.
- Compost market is too far from the production point.
- Compost is difficult to spread manually.
 - Use of compost is unknown
- Insufficient knowledge of the value and possible uses of organic waste compost as a soil additive.
- Consumers' perception of compost containing pollutants and impurities.
- Lack of government intervention and initiative in promoting the use of compost
- Poor linkage with the agriculture sector.

Furedy (1990) reported that in Chinese cities, urban waste had been extensively used in peri-urban agriculture. The subsidies on chemical fertilisers, the odour of decomposed waste and the dissatisfaction with synthetic and glass material contamination led the farmers to reject city wastes.

A study conducted by SANDEC in Karachi, Pakistan reveals little evidence of compost use, lack of awareness of the farmers about the benefits and utility of compost and therefore lack of demand for compost (Zurbrugg and Drescher 2002).

A study conducted in Tanzania pointed out that the farmers were jeopardized by fears of the contamination of vegetables produced from compost (Kassenga 1999). In Karachi, Pakistan and in Tanzania all potential users have rated the problem of water

shortage/ availability on higher scale than the supply of nutrients and organic materials into the soil (Kassenga 1999; Zurbrugg and Drescher 2002).

Summary from the section

Compost has potential as a soil conditioner. But due to lack of government initiative and know-how of the farmers the demand for compost is lacking.

2.15 Market for Compost

Agriculture, horticulture, home gardening, nurseries, and municipal gardens and parks are the major markets for compost. In the developed countries compost is also used in landscaping, land reclamation, landfill cover, top soil blender and golf courses. Two types of market exist for compost – one is the high value-low volume and the other is the low value-high volume market. In the high value-low volume market, the customers are willing to pay a high price and want good quality compost. In the low value-high volume market, the customers want bulk volume at a lower price (Dulac 2001; Tyler 1996). The most important areas of compost application are:

- Agriculture is the largest potential market for compost (Hart and Plumiers 1996). The potential of compost in (peri-) urban areas for crop cultivation is highly focused in the studies of Drechsel and Kunze (2001), Harris et al. (2001), Brook and Davila (2000), Smit and Nasr (1992). (Peri-) Urban agriculture can ensure food security, improve the environment and contribute to urban economies. International funding and research agencies are increasingly recognising the great potential of organic waste in urban agriculture and are advocating for bringing agriculture back into the towns and cities (Asomani-Boateng and Haight 1999; Drechsel and Kunze 2001).
- Horticulture, the growing of fields of fruits and vegetables in the (peri-) urban areas, is a promising market for compost. Organic farming is becoming a growing industry that utilises food wastes to produce fresh foods for the city dwellers (Smit and Nasr 1992). Asia has the growing and exporting potential for organically grown products. The growing interest in organic methods of farming and exporting by Asian countries such as Japan, China, Sri- Lanka, Philippines, Indonesia, Malaysia and India is increasingly recognising the great potential of organic solid waste reuse and recycling in

urban lands (Silva 1995). Bangladesh, with the help of the Hortex organic programme, is producing and exporting baby pineapples and organic vegetables (Caldas 2001). Organic farming is more expensive than the traditional farming. Organic foods and vegetables are more highly priced than the conventionally grown foods. The market for organic foods is limited but people from the United States, European Union and Japan who usually buy organic products are motivated by an increased awareness of health and safety (Hart and Pluimers 1996).

- Home gardening in yards, containers, roof-tops and balconies is very popular. The urban residents grow ornamental plants and flowers to beautify their houses and sometimes vegetables to supplement their household diets (Hart and Pluimers 1996).
- Nurseries in the urban areas grow ornamental plants and flowers. The nurseries are the main suppliers of saplings for city plantation and greening programmes and are potential users of compost.
- Landscaping, public parks and green belts maintained by municipal agencies have a large usage of compost. But due to the lack of a link with product promotion, a demand for the compost has not yet been created (Zurbrugg 2003).

2.15.1 Competition

Urban solid waste compost has to compete with the inorganic fertilisers and the other locally available organic manures in terms of price and availability to gain a position and to develop a market.

2.15.1.1 Organic compost and Chemical fertiliser

Compost plays an important and complex role in maintaining soil productivity and the composition of humus in soil. It is a source of valuable mineral and organic matters. Compost usually contains macro-nutrients [N= 0.4-1.6%, P= 0.1-0.4%, K= 0.2-0.6%] lower than the chemical fertiliser [N=46%, P=23%,K=39-52%] (Dalzell et al. 1979). But the nutrients are organically bound and released slowly throughout the growing seasons making them less susceptible to loss by leaching compared to soluble

fertilisers (Rabbani et al.1983). European research has established that only 30 to 40 % of the applied chemical fertilisers are used for crop production, as the rest are washed away (Urban Agriculture Magazine 2002). In addition to macro-nutrients, compost often contains micro-nutrients or trace elements such as iron, manganese, copper, boron, zinc, molybdenum which plants need in small quantities (EPA 1993). Compost needs to be applied in a higher quantity than the chemical fertiliser in the crop fields (Diaz et al.1993). But compost retains moisture and binds nutrients from leaching for a long period (Lardinois and Klundert 1993). Dulac (2001) reported from South Asia that cost monitoring had shown that using compost in rice fields reduces the cost of purchasing and applying pesticides and herbicides compared to the application of chemical fertiliser.

Chemical fertilisers are easy to transport and apply. They react quickly on crops. Chemical fertilisers are cheaper due to government subsidies. Sometimes chemical fertilisers are expensive and simply unavailable. Many farmers cannot afford to purchase fertilisers on a frequent and regular basis because of market fluctuations in price and supply (Allison et al. 1998).

Combined application of compost and chemical fertilisers enhances the productivity and sustainability of agriculture systems especially for soils with low organic matter. The chemical fertilisers could not be replaced entirely by organic composts because the higher quantity of compost may have an inhibitory effect on seed germination (Diaz et al. 1993). The effects of application of organic compost in conjunction with chemical fertilisers are complementary to each other and allow the chemical fertilisers to remain in the soil matrix rather than being washed away and thus increase the nutrient supply to the plants (Diaz et al. 1993). Compost yield trials in Bhaktapur, Nepal on potato and onion showed that the best results were found when chemical fertilisers were used along with compost (Dulac 2001). In Manila an application ratio of 50% compost and 50% chemical fertiliser (by weight) was popular for higher yields (Lardinois and Klundert 1993).

2.15.1.2 Compost and other competing organic fertilisers

The practice of manuring lands for food cultivation is not new to farmers. Farmers know the beneficial effect of organic application into soil to give good harvests. The farmers use various types of traditional organic manures like green manure, farmyard

manure and poultry litter to maintain and improve the productivity and fertility of their agricultural soils. But these traditional local manures are gradually declining or alternatively being used as fuels (Lardinois and Klundert 1993).

Summary of the section

Chemical fertilisers are subsidised by the government and so are cheaper than the compost. Compost maintains humus in the soil and is a source of valuable mineral and organic matter. Farmers are aware of the value of organic inputs. Compost has to compete with chemical fertilisers and locally available organic manures in terms of nutrient content and price.

2.16 Marketing strategies for compost

Marketing of compost is the key area of concern for the composting process. From the experience of many countries, it is evident that due to lack of marketing strategies for the product, most of the compost plants have closed or been scaled down. Marketing strategies are the important controllable marketing tools that can influence the demand for the product in the target markets (Kotler 2003). For successful marketing the manufacturer may try to influence the product demand by designing a quality product which is workable, affordable, readily available and communicable to the end-users. Compost marketing is defined by EPA (1993, p-35) '*Compost must be available at the appropriate time of the year, be consistent in composition and nutrient content, contain low levels of potentially toxic substances and be offered at a low cost bulkiness must be resolved, distribution channels must be established and the positive effect of compost on crop yields demonstrated*'.

According to a citation from the Warner Bulletin (1997, p-5) – '*If waste derived composts.....are to be marketed, they must reach an acceptable quality... be able to compete effectively on price, quantity and continuity of supply, environmental benefits and general acceptability to the public and commercial interests*'.

GTZ (1999) in a case study report on organic waste utilisation noted that before launching the compost product the following marketing aspects need to be considered.

That includes:

- Acceptance of compost
- Competing products for compost
- Possible marketing infrastructure
- Ascertaining quality demands on the product
- Relevant knowledge of potential users
- Price formation
- Promotional activities or publicity

From the above discussion, the four key marketing strategies; quality, price, distribution and promotion, are outlined for successful marketing of compost.

2.16.1 Product Quality and Safety

Product quality establishes a positive image, builds customers' confidence and helps to open the commercial outlet of the product (Barth 2001). The quality of compost is determined substantially by the type and composition of the feedstock materials and by the proper management of the maturation process. The composition of compost raw materials can vary due to the non-homogeneous nature of waste and its seasonal variation.

There are various compost quality standards in different countries such as UK PAS 100, EU Eco-label, German Federal Biowaste Decree and Australian Bureau of Standards. The Canadian National Compost Standard serves as an example of quality criteria for compost. Here the quality of compost is assessed against six parameters (Box 2.5).

Box 2.5 : Canadian National Compost Standard

Parameters	Quality guidelines
Compost stability and maturity	Compost should be stable and fully decomposed. It should be clean, free from attraction of flies and absence of obnoxious odour. C/N ratio should be $\leq 25 : 1$ pH ≈ 7 , which indicates neutral substance The stability and maturity of compost can be tested by : <ul style="list-style-type: none"> • Visual test- Dark-brown colour, when squeezing feel like a sponge or crumbliness and a squeezed handful of compost should leave the skin wet. • Odour test - Earthy odour • Temperature test - Temperature of the pile dropped down to 20 ° C
Foreign matters	Compost should be virtually free of foreign matters (glass, metal, plastic etc.) that may cause nuisance, damage or injury to humans or plants during its intended use. It shall contain no sharp objects measuring over 3 mm in any dimension and no foreign matter greater than 25 mm in any dimension.
Organic matter content	Organic matter content in compost should be 20-40 percent.
Heavy metal contaminants	Compost should not contain heavy metals (Cd ≥ 3 mg/kg, Pb ≥ 150 mg/kg and Hg ≥ 0.8 mg/kg) above the permissible limit which may accumulate in the soil and then transfer to plants and ultimately enter into the food chain.
Micro-nutrients and trace elements	Compost is a good source of supplying micronutrients or trace elements such as Arsenic (≤ 13 mg/kg), Copper (≤ 100 mg/kg), Chromium (≤ 210 mg/kg), Zinc (≤ 500 mg/kg), Nickel (≤ 62 mg/kg) and Molybdenum (≤ 25 mg/kg) which plants need in small quantity.
Pathogen	In the composting process temperature should be elevated more than 55°C and maintained for three consecutive days to

(Adapted from Bertoldi et al.(undated))

2.16.2 Price

Price is the amount of money charged for a product. Price is normally set for generating revenue and gaining profit. The customer perceives price as a means of comparing products, exchanging relative value and quality for money. The price is highly influenced by the quality of compost produced, the marketing strategy applied and type of consumer addressed for buying the product. Kotler (2003) mentioned three main pricing approaches.

- Cost -based pricing : based on cost of production and transportation

- Value-based pricing: setting price based on buyer's perception of value rather than on the seller's cost.
- Competition-based pricing: setting price based on the price that competitors are asking for similar type or purpose oriented product.

Compost price can play an important role in the fertiliser market. Some of the pricing criteria for compost are:

- Compost price must be fixed within the ability and willingness to pay by the users (Diaz et al. 1993).

In Calcutta, India a compost plant established in 1976 with a production capacity of 40,000 tons/year closed down although the demand for compost was high. The production cost was higher than the price the farmers were willing to pay for compost (Lardinois and Marchand 2000).

- Compost price must be nearer to the price of the competing products.

The production cost in different composting plants in Thailand, Nepal and India was higher than the revenue earning from sale of the compost because of the market limitation on prices of compost (Diaz et al.1993).

- Produce a variety of products and sell at different prices to offset the loss from any sale.

Terra-Firma Bio-Technologies limited in India (Lardinois and Marchand 2000), Waste Busters in Pakistan (Pervez 2004) and Eco-Composting in UK (Dlampney 2002) produced a number of products with varying prices, qualities and purposes.

2.16.3 Distribution

Distribution of compost depends on the location of the composting facility, the distance from the end-users and the available marketing network.

2.16.3.1 Location

Location of compost facility and market is very important when considering availability of raw materials and transport issues (EPA 1993). The compost facility is mostly of urban origin but the urban market for compost is limited or underdeveloped. Large users of the compost product are often from a rural or agricultural setting. A

reliable and effective distribution network involving the wholesalers, dealers and retailers is important for a reliable supply of the compost to the end-users.

2.16.3.2 Distribution channels or networks

Marketing or distribution channels are a set of interdependent organisations involved in the process of making a product available for use or consumption by the customers (Brassington and Pettitt 2001). The channel consists of producer, wholesaler and retailer. Each has a separate business seeking to maximise its own profit. An efficient distribution system can enable the product to be available to the customer at the right place at the right time via a wholesaler or from a retailer outlet. Marketing is most reliable when existing distribution channels are utilised. From the experiences of marketing, most of the sale flows are hindered due to a lack of distribution channel, institutional structure or commercial intervention (Dulac 2001). Fertiliser dealers traditionally have the distribution networks for chemical fertilisers. They have good perceptions of the needs of the various user groups they serve and are able to sell compost. Coad (1996) suggested that pesticide distribution companies may be an effective channel for compost distribution and sale because of their good links with the agriculture sector. Terra Firma of India sells its compost through a large fertiliser distribution company (Zurbrugg 2002). Excel Industries Ltd. has a nationwide distribution and sale network of its agro-chemicals which provides the marketing and circulating advantage for selling its own compost (Hoomweg et al. 1999).

2.16.3.3 Product availability

It is important to have an adequate and reliable supply of product whenever customers demand it. This is even more critical when demand is seasonal. Compost production and raw material generation is throughout the year but compost demand and application is seasonal (Yousuf 1996). The production has to be designed accurately so that no overproduction or underproduction could influence the delivery schedule. Compost must be consistently available; sporadic availability may lose the confidence and interest of the users. Inability to meet the commitments causes bad customer relations and destroys the credibility of the product (Albrecht 1987). Pervez (2004) reported that in Pakistan demand for compost is all year round but in the peak seasons

during the rice and wheat cultivation the demand and sale of compost goes up. Dulac (2001) stated that in South Asia demand for compost has been increased by 10 to 15% in the winter season.

2.16.3.4 Transportation

Compost is bulky and costly to transport. The urban market for compost is limited. It needs to be transported out of the town or even over long distances. Transportation of compost to a distant rural area involves large expenditure. Normally the transportation cost is added to the market price and is borne by the customers. This is sometimes difficult for the rural farmers to afford, so the sales are confined within an economic distance (Asomani- Boateng and Haight 1999). A feasibility study conducted by EPA (1993) reported that compost could be sold economically at a distance of 20-25 km due to its relative economic value. A study from Asia suggested that the market radius for compost must be limited to about 25 km from the plant, beyond which the price would no longer be competitive (Lardinois and Klundert 1993). Eco-Composting, the successful compost marketer in the UK, actively markets its compost within a 30 km radius of the plant (Dlampney 2002).

But in Pakistan (Lahore), Waste Busters was transporting compost to the furthest distance (up to 1000 km) at a higher price because of its high demand, but subsequently suggested that the best option is to sell within a 200 km radius (Pervez 2004). In Cairo, Egypt the compost was sold to farmers at a radius of 100 to 150 km where a high demand existed because of the sandy soil in the desert area (Lardinois and Klundert 1993).

2.16.4 Promotion

Promotion is a communication technique which influences the buyer by creating and changing attitudes, developing positive feelings and desires to acquire the product (Brassington and Pettitt 2001). Promotion includes displays, attractive and informative packaging, brochures, advertisement, the acquisition of a suitable brand name and logo. The purpose of promotion is to tell the customers about the benefits of compost, to build awareness and encourage customers to buy compost. Promotion of

compost can be achieved by better public relations, sales promotion and advertisement.

2.16.4.1 Public relations

Public relations is a promotional tool which can be established by building good relations with the customers, by product publicity, and by building a good image of the product. The primary goal of public relations is to create a positive image of compost and to encourage customers to buy and use it. Public relations may increase public awareness. Public education on compost application and its benefits, procurement information and demonstration of the effectiveness of compost on crop growth can influence the buyers to buy compost. The relationship with the customers can also be established by free distribution of compost to the high profile users, whose recommendation would influence a large volume of customers by word of mouth. It is done at the outset by leaflets, brochures or posters or meetings with the target customers. Promoting or advertising compost through national media, community campaigns or education programmes, advertisements in specialist newspapers, magazines or dissemination of information through agricultural programmes on the radio could all gain the attention of the users (Lardinois and Klundert 1993; Dulac 2001).

2.16.4.2 Sales promotion

Sales promotion consists of short-term incentives to encourage the consumer to buy a product. It is a consumer relations building tool. Three tools are used to accomplish sales promotion (Kotler 2003):

Consumer promotion tools

These cover a wide variety of short-term incentives. Some of them which may relate to compost promotion are described below.

Consumer promotional tools	
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Samples	Samples are small amounts of a product offered to consumers for trial. Samples are provided free.
Coupons	Coupons are incentive certificates that give buyers a saving when they purchase.
Premiums	Premiums are goods offered either free or at low cost as an incentive to buy a product.
Patronage rewards	Patronage rewards offered for the regular customers

Trade promotion tools

These are the manufacturer's direct sales promotions towards retailers and wholesalers.

Trade promotion tools	
Discounts	Discounts are straight reduction in product price on purchases.
Allowances	Allowances are the incentive money or commission offered by the manufacturer to retailers against the sale.

Business promotion tools

These are used to generate business leads, stimulate purchases, reward customers and motivate sales people. Business promotional tools include many of the same tools used for consumer or trade promotions.

Business promotion tools	
Demonstration of products	Demonstrate the value or utility of the product to generate awareness of the customers and draw their attention and purchase intention.
Sales contests	Sales contests are the competitions for salesman or dealers to motivate them to increase their sales performance against receiving cash prizes or gifts.

2.16.4.3 Advertising

Advertising is the use of paid media by the seller to inform, persuade and remind about the product. *'Advertising is a paid form of non-personal presentation and*

promotion of product by an identified sponsorship' (Kotler 2003). Two types of advertising media are used.

Informative advertising

- Tell the market about the product
- Explain usage (how the product works) of the product.
- Describe procurement information (where to buy the product).

Persuasive advertising

Brand preference and informative packaging are used as persuasive advertising.

2.16.4.3a Product branding

Branding is a major issue in product marketing strategy. *'A brand is the product identity in name, term, symbol or logo or a combination of them , intended to identify the goods and to differentiate them from those of competitors and to make it easier to buy or sell'* (Kotler 2003).

The benefits of branding are outlined by Brassington and Pettitt (2001):

- Easier product identification
- Communicates features and benefits
- Helps to build trust in product
- Establishes product's position in the market
- Reduces risk in purchasing
- Creates interest for purchasing the product

2.16.4.3b Packaging

Packaging enhances product image and appeal, communicates product information and identification, and helps to ease handling and conveyance. Brand name, trade mark, weight, fertiliser type (with nutrient contents and recommendation for appropriate dose), storage and handling procedures of compost are labelled on the

package. This establishes product credibility and builds customers' confidence and trust. Generally, compost from waste is labelled with the recycling symbol that creates an environmentally friendly appeal. Product acceptance can be quickened by creating a positive image through an appealing name (Segall and Alpert 1990).

Summary of the section

Marketing strategy of compost is a combination of four key approaches: product quality, pricing, distribution and promotion.

- Compost product quality is mainly confined to stability and safety of the product.
- Price of the compost is dependent on three pricing criteria namely cost-based, value-based and competition-based.
- Distribution of compost depends on the reliable supply of compost to the end-users. In some cases, established fertiliser or pesticides marketing networks are used for effective marketing.
- For compost public relations, sales promotion and advertisement are the key promotional tools.

2.17 Synthesis of literature review

The literature review helped the researcher to get insights into social, institutional, legal, financial and economic issues associated with community-based solid waste management. The key aim of the research is to develop a sustainable and replicable waste management model for the decision makers as a solution to the city waste problem. The literature shows that a number of community-based composting projects are piloting in the developing countries as a technical innovation and are still at the infancy stage. Community-based solid waste management is a relatively new area of research. No theoretical framework for the sustainability of community-based solid waste management projects has yet been developed. Water supply projects have a long history of community participation and management. The water, sanitation and other infrastructural services literature were reviewed as a basis for discovering the relevant indicators for sustainability and replication of community -based composting projects.

Sustainability is not a big word for a big thing. It can be started from an individual level up to collective effort of the community residents. The community is the main instigator of any community development effort. From the literature, it is found that community participation is now a pro-active process in which the beneficiaries influence the development and management of the projects rather than merely receive project benefits. Other essential elements of sustainability and replication are:

- Community must have demand and positive attitude towards the project.
- Community must feel responsible for the project.
- Community must be willing to share the project cost.
- Community must have the management capacity needed for the project.

The reflection of a community's needs and priorities, cost sharing, capacity building and growing ownership may be important indicators to evaluate the sustainability and replicability of the community-based composting projects.

Local governments are the responsible authorities for waste collection and disposal. They are the legal owners of waste once it is collected or disposed of for collection. Their support and acknowledgement is imperative for any waste management activity. Local governments are motivated by political interests as well as legal obligations. From the literature, it is found that the local authority can assist community-based solid waste management project by providing facility support, by formulating favourable policy/legislation, by providing financial assistance or by guiding with promotional activities. On the contrary, community-based initiatives may be restrained by political interference or by municipal non-cooperation when community initiatives are perceived as a threat to municipal activities. Favourable municipal perceptions and attitudes, administrative and political environment, formal recognition and mutual commitment are essential for the smooth functioning and sustainability of the community-based composting project.

From the literature, it is found that community-based composting projects have a poor reputation in terms of prices covering costs. Community-based initiatives may need initial financial support from the external agencies. But it will be a risk if they become dependent on external support. Until recently, the traditional cost accounting system which does not reflect the actual costs as well as the benefits of the projects has been

followed in solid waste sector. The actual financial situation of the community-based projects may be accounted for by a full cost accounting system which can uncover the overhead, indirect and hidden costs as well as benefits. Moreover, it reports cost reduction and cost recovery figures with the future outlay, which may be helpful for relative comparison and to take political decisions.

From the literature, it is found that composting has been practised in the rural areas for centuries. In urban areas, farmers had access to relatively uncontaminated urban solid waste from mining of waste dumps. But the increasing contamination of solid waste from different sources has led to a decline in organic waste reuse. Theoretically, there is an unlimited demand for compost in crop cultivation. But in reality, there are more limitations on compost use. These are:

- Insufficient knowledge of the end-users about the value and use of waste-derived compost.
- Consumer's perceptions of compost containing pollutants of urban waste.
- Lack of government initiative to promote compost in agriculture.
- Compost market is too far from production point. It becomes costly to transport.
- The competing products are easily available to the end-users.

Against this backdrop, the assessment of demand, the marketing environment and marketing strategies such as product quality, pricing, distribution and promotion of the compost will need to be evaluated to look into the present status and future implication for the sustainability and replication of community-based composting projects.

From the literature, it is found that community-based projects need to be considered by an integrated approach of community, government and business. A few studies have been conducted by Department of Water and Sanitation in Developing Countries (SANDEC) on composting (www.sandec.ch). These studies discussed some successful and unsuccessful cases of composting and guided the literature to find out the potentials and limitations of community-based composting. Another resourceful literature source was Waste within the UWEP (Urban Waste Expertise Programme) (www.waste.nl) which provided the research to develop the indicators of

sustainability and replication issues. Finally, some of the case studies on composting in developing countries (Ali 2004) (www.lboro.ac.uk/wedc) contributed with practical guidelines. No detailed study has been done on the sustainability and replication issues of a community-based composting project in an integrated manner considering the community, local government, financial aspects, and demand and marketing. The literature review identifies a significant gap for a holistic view of community-based composting to assess the sustainability and replication issues. This research attempts to address this gap, and to develop a sustainable and replicable model for decision makers and implementers.

This research is based on existing cases and it has application in the field on solid waste management. There is scope to learn and contribute ideas. In the existing institutional arrangement solid waste disposal is the responsibility of the local authority and the people are paying municipal taxes for the service. In this context, when sustainability and replication of the community-based composting projects are concerned, the research will contribute to the existing knowledge by examining the community's needs and priorities, responsibilities for the service, willingness to cost-share and management capacities. In the present waste management system, the local authority acts as a service provider but this research looks at the local authority role as a facilitator for the community-based composting project. In the traditional cost accounting system, the actual costs of composting projects are not reflected. This research uncovers some of the overhead, hidden and indirect costs and benefits by use of a full cost accounting system. Composting has a long history of practice in rural agriculture but it is now considered as a waste management approach too. For the sustainability issue, this research looks at waste management and the use of its by-product in an integrated way by the assessment of demand, the marketing environment and key marketing instruments.

CHAPTER 3

RESEARCH STRATEGY AND FIELD WORK METHODOLOGY

3.1 Introduction

The main contribution of the research is to develop a sustainable and replicable composting model by evaluating the existing community-based composting projects of Bangladesh to guide the decision makers to adopt composting as a solution to city waste disposal. In Chapter 2, literature review, the potentials of small-scale community-based composting projects for the management of organic wastes were emphasised. Most of the cases presented particularly focused on community waste collection and composting activities funded by external support agencies, with sustainability and replication as the main issues identified. In the literature, community participation, local authority support, financial feasibility, demand and marketing issues were highlighted as essential factors for the successful implementation of the composting projects. However, no integrated work has been done on how and to what extent these factors contribute to the concept of sustainability and replication of the projects.

The research investigation began with an exploratory process through a review of the project reports of the composting projects and initial field verification of the existence and nature of the projects to justify whether the cases are restricted to just the case study examples or have implications across the broad area of waste management. The rationale for the selection of the cases is that they represent unique pilot cases which are being replicated without detailed investigation of the sustainability issues. Moreover, solid waste disposal is a prime area of concern for the municipalities that are constrained by shortage of landfill space and are looking for a solution for waste reduction. Composting is the only waste treatment method and is being piloted for the first time as a demonstration project for organic waste recovery and recycling in Bangladesh. Thus the cases considered here will contribute to the decision making process of the municipalities.

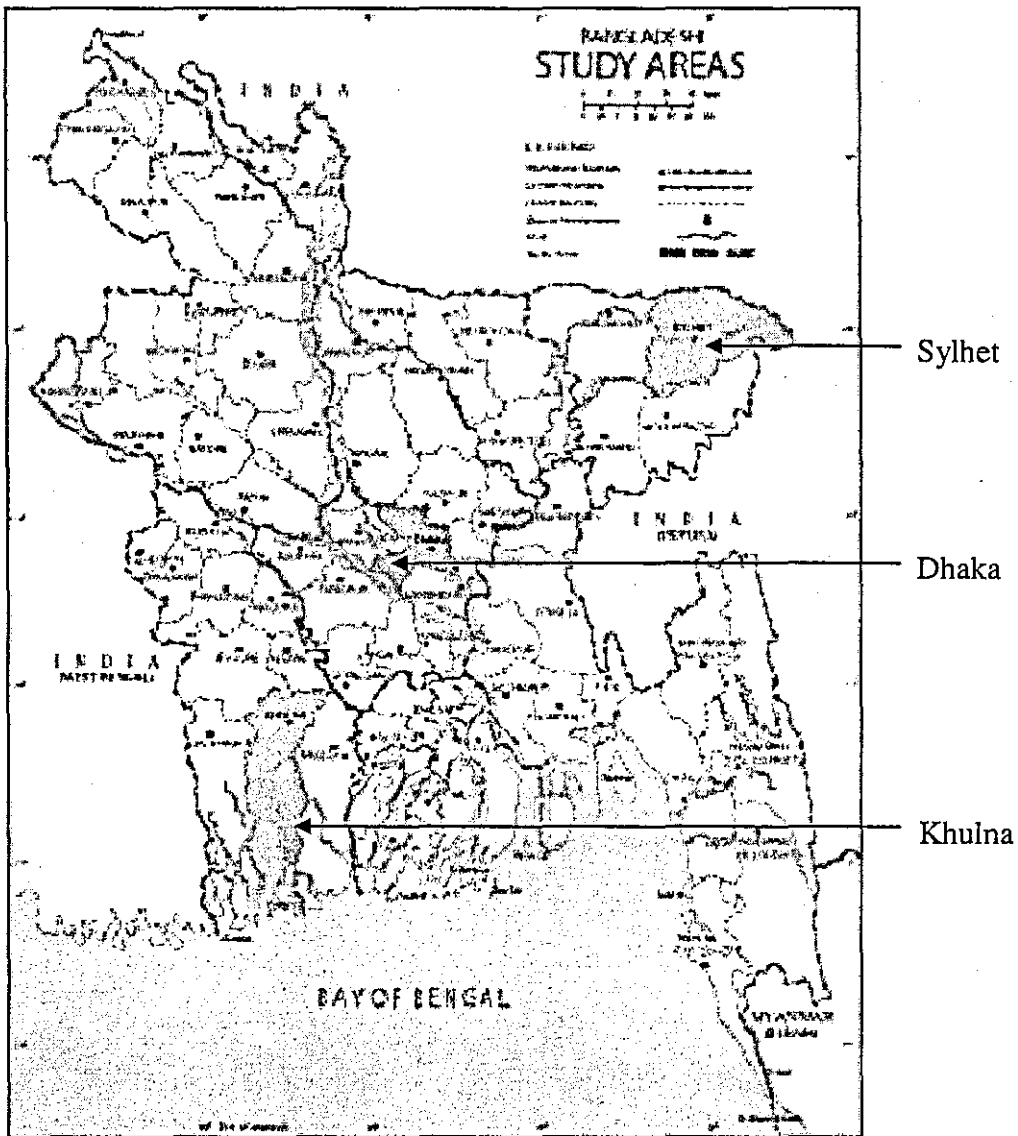
After the exploratory phase of the research, the next emphasis was given to the appropriate design of the methodology, for the process of field work and analytical framework for data analysis which are presented in the following sequences:

- The context
- Aims and Objectives
- Guiding hypothesis
- Research Questions
- Research strategy design
- Data collection methods
- Methods for data analysis

3.2 The Context

This research was urban based considering the solid waste disposal problems for the larger cities of Bangladesh. In this research, four cases in three cities Dhaka, Khulna and Sylhet were selected (Box 3.1, Map 3.1). These are the divisional cities and city corporations that administer solid waste management. The socio-economic and cultural characteristics of these cities were very similar to those in many developing countries. Local initiatives for neighbourhood waste collection activities were very vibrant in these cities.

Box 3.1 General information of Study areas		
<p>Bangladesh Total land area : 142776 sq.km Climate: Tropical, warm, heavy rainfall during monsoon season Avg. temperature : Summer - Warm, 30 to 37 ° C Winter - Cool , 10 to 20° C Humidity around 80 percent Annual rainfall : Low 150 cm, High 500 cm Population (1997): 125,340,000 Annual growth rate : 1.8 percent Urban growth rate : 6.83 percent Population density (Urban area) : 723 / sq.km % of urban population in larger cities : 35.0 Average household size : 5.6 Per capita income (1997): US \$ 247 GDP : US \$ 14.89 million (Source : BBS 1997)</p>		
<p>Dhaka Area : 131 sq.km Population: 5.7 million Slum population : 1.3 million Waste generation : 3200 tons/day Waste generation rate: Domestic : 0.34 kg/cap/day Total : 0.56 kg/cap/day Number of electoral wards : 90 Total disposal : 1400 ton/day (. Source : JICA 2005)</p>	<p>Khulna Area : 70 sq.km Population: Estimated 1.2 million Waste generation : 200 tons/day Number of electoral wards : 31</p>	<p>Sylhet Area : 26.5 sq.km Population: Estimated 0.5 million Waste generation : 120-150 tons/day Number of electoral wards : 27</p>



Map 3.1: Location of the study area

(Source: Bangladesh Guide Map, The Mappa, 2004)

The general overview of the solid waste management of the cities is given in Chapter 4. This research was based on community-based composting, where primary waste collection was an integral part of the project. The composting projects were located in the community area. The community residents' role was vital for both their participation in waste delivery and in financial contribution to the service. These projects were evolved as pilot cases for the reduction and recycling of organic waste in Bangladesh. Attempts had been made to replicate these cases in different cities before a detailed investigation of the sustainability issues are evaluated. The composting projects selected in this study were low cost and labour intensive and were suitable for the developing countries both economically and culturally. In

addition, they had scope for employment generation for the urban poor. In this context, after evaluating the potentials and limitations of the community-based composting projects of Bangladesh, a generalised model could be developed for replication in other cities of the developing countries.

The following four cases were selected for this study (detail description in section 4.5):

- **Public-Private-Community partnership composting project**

Waste Concern, a local NGO working as a pioneer in community based composting in Bangladesh, has developed a Public-Private-Community partnership model in three communities in Dhaka city. The UNDP, under its sustainable environmental management programme, supported the projects with the Ministry of Environment and Forest coordinating, and the Public Works Department and Dhaka City Corporation providing lands and other logistics. Communities were participating in door-to-door waste collection activities and paying fees for the services. The NGO, Waste Concern, was providing technical support and facilitation for composting and a private fertiliser company was engaged in compost selling.

- **Community operated-NGO facilitated composting project**

This is an attempt to provide low-cost and sustainable solid waste management in the urban slums of Dhaka city, which are devoid of formal solid waste management services.

The objective of the project is to improve the environment of the slums and squatter settlements by providing a solid waste disposal facility, as well as creating income opportunity for the urban poor in the slums. This project was initially supported by the LIFE-UNDP (Local Initiative Facility for Urban Environment) programme and subsequently by the UNDP-SEMP programme. Waste Concern, a local NGO, provided the technical assistance and the women of the slums segregated waste into organic and inorganic categories and put them in two different coloured barrels.

- **Community-based composting projects on NGO-CBO collaboration**

This project is an attempt to provide a uniform solid waste collection service in Khulna, one of the divisional cities of Bangladesh, by engaging the existing CBOs who built their capacities in neighbourhood waste collection from an earlier project of WSP-SDC. Prism, a national NGO in Bangladesh, which has long experience in duck weed-based waste water treatment, has established a network among 14 CBOs for solid waste collection services and constructed two community-based solid waste composting plants. This project is supported by UNDP-SEMP (Sustainable Environmental Management Programme) with the project funds being utilised for compost plant construction and supplying bins to the households for keeping wastes. In some neighbourhoods the project introduced source-separation by providing two different coloured containers to the households.

- **Community composting project run by the private company**

Sylhet Partnership began as a 'not for profit' organisation in 2001 with the aim of addressing the key urban problems of Sylhet, a new divisional town in Bangladesh. It was a twin city collaboration accord under the European Commission Asia-Urbs Programme. The London Borough of Tower Hamlets, the Municipality of Horsens, Denmark and Sylhet City Corporation were the key partners of the Programme.

One of the main problem areas identified by this programme was solid waste management of the city. The Sylhet Partnership programme started residential and commercial waste collection activity and litter bins installation in the main thoroughfares of the city with the aim to 'Keep Sylhet Clean'. The programme relied primarily on a European Union grant for two years and suffered a cash flow problem when the grant ended. It then regenerated as a company and started composting activities on rented community land, developed its own workforce, capital programme and marketing strategy around the collection and recycling of residential wastes and was trying to achieve self-funding capacity.

The four composting projects covered three divisional cities of Bangladesh. The cases were of different natures, which supported the multiple case studies approach (Table 3.1).

Project activity	Community-based composting project of Waste Concern	Barrel composting project in slums	Community-based composting project of Prism	Community composting of Sylhet Partnership Company
Mode of Operation	Public-Private-Community partnership	Community owns the project facility, NGO acts as a facilitator	NGO-CBO collaboration	Began as a 'not for profit' organisation but later on regenerated as a private company
Financing	UNDP grant, collection fees, compost sale	UNDP grant	UNDP grant, collection fees, compost sale	Collection fees, compost sale
Primary waste collection	By the NGO Waste Concern	Slum dwellers manage by themselves	By the CBOs	By the company
Community participation	Waste delivery, collection fees	Source-separation, put waste in barrels	Waste delivery, Source-separation in some residential areas, collection fees	Waste delivery, collection fees
Local Government support	Land provided free of cost for composting activity		Recognition of the CBOs activity	Office accommodation
Flow of fund	Donor → NGO	Donor → NGO	Donor → NGO → CBO	Initially funded from European Union, Now Self-funded
Incentive or support to community		Provide barrels for composting , get money from compost sale	Provide containers for waste storage and source separation	
Composting activity	By the NGO Waste Concern	By the slum dwellers, NGO technical assistance	By the NGO Prism	Sylhet partnership company
Compost plant location	Within the community	Within the community	Outside the community with no habitants nearby	In another community not included in primary waste collection coverage.
Compost sale and marketing	By the NGO through private fertiliser company	By the NGO through private fertiliser company	By the NGO with the support of agriculture extention department	By the company through dealers margin and credit support to farmers

3.3 Aims and objectives

Solid waste management is receiving special attention of the city governments as it consumes 30 -50 % of the municipal budgets and is able to manage only 50% of the

generated wastes (WRI 1989). Waste recycling and recovery is the only way to contribute to waste reduction and save the municipal budget.

The broad perspective of the research was to protect the urban environment from improper waste management and to explore and promote economically efficient and environmentally sound waste disposal system for developing countries. To seek to achieve this objective, the research was directed towards a common goal of achieving economic and environmental sustainability with due consideration to social and political issues and come out with a sustainable and replicable model for waste management by organic waste recycling.

The broad aim of the research was to encourage organic waste recycling through developing a sustainable and replicable model for the decision makers which encompassed the issues of community participation, local government perceptions and attitudes, financial and operational performance; and compost demand and marketability. The specific aims of the project were:

- to assess the attitude, awareness and willingness of the community to participate in a community-based composting project.
- to look into the awareness, attitude and policy framework of the municipal authorities.
- to evaluate the financial and commercial viability of the composting project.
- to investigate the supply-demand scenario of the compost product and to explore the demand and marketing issues of the product.

3.4 Hypothesis

The hypothesis is the guide to address the research problem in the form of a relationship between dependent and independent variables. This entire research was guided by the following hypothesis:

‘Community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered’.

This hypothesis has three underlying fixations- sustainability and replication, present stage of development and strategic issues. To qualify the hypothesis, five operational definitions¹ are explained in footnote.

3.5 Research questions

Research questions are the central themes which have a logical priority over the method of research. They focus the study and give guidance on how to conduct it (Maxwell 1996). Research questions have five functions (Punch 1998):

- They organise the project and give it direction and coherence
- They delimit the project, showing its boundaries
- They keep the researcher focused during the project
- They provide a framework for writing up the project
- They point to the data that will be needed

Key research question

In the last decades, a number of composting projects have been carried out in developing countries. Some of the projects were in collaboration with external support agencies and some were directly imported from western countries. Some projects were successful in producing lasting impacts. However, many projects could not support themselves or expand further when the external support agencies discontinued their support. In these circumstances, the key focus of the research will be encircled by the following key research question:

¹ (i)Community-based composting project: is an approach to manage the generated solid waste within the community in which community members participate in the project activity by providing support in kind or in cash. In this project, primary waste collection is the main activity where composting has been developed as a subsidiary activity to reduce and recycle the organic waste stream.

(ii)Present stage of development: the community-based composting projects are mostly running on donor support and represent demonstration projects to qualify waste reduction and resource recovery of waste.

(iii)Sustainability: defines the projects as having the capacity to function without external assistance, or the achievements of the project will continue after the stipulated project period.

(iv)Replication: indicates the projects achievements can be executed in other places in similar natural settings.

(v)Strategic issues: Community motivation and participation, local government support, financial and commercial opportunities, demand and marketing potentials of the compost product are the strategic issues.

How sustainable and replicable are the community-based composting projects for the management of solid waste in developing countries such as Bangladesh?

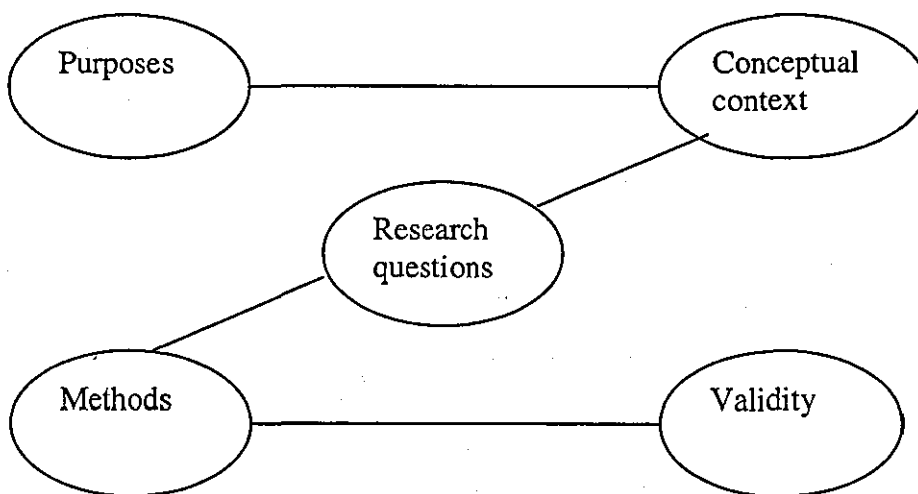
The key research question led the researcher to investigate the potential of community-based composting along with secondary research questions. A number of secondary questions were selected to answer the primary question. The secondary questions were designed based on four main aspects, namely (i) Community awareness and participation (ii) Local government perceptions and attitudes (iii) Financial viability and (iv) Demand and marketing. The secondary research questions along with the objectives and purpose are explained in Table 3.2

Table 3.2 Research questions, objectives and purposes		
Research questions	Objective	Why?
What motivation and attitude does the community have towards composting? What is the impact of composting on the community and how does the community accept it? What is the level of participation of the community? In what way is the community contributing to the composting project which is likely to affect the sustainability and replication of the project?	To assess the awareness, attitude, interest and preferences of the community to participate in waste separation and willingness to use and pay for composting projects. To ascertain community support, ownership feelings and level of participation of the community residents.	In the existing practices community motivation and participation is only limited to waste delivery and paying collection fees. Community participation in waste segregation, compost use and willingness to pay for composting operation will show community interest. The level of participation and contribution of the community will show responsiveness and ownership feelings.
What awareness and attitudes do local government officials have towards waste reduction and composting? What legal and political environment exists in the local government authorities and how does this impact on the sustainability and replication of community-based composting projects?	To look into the local government officials' awareness and attitude, political environment and prevailing policies in support of community-based composting activities.	Local government officials' knowledge, strong political will, favourable government policy and acknowledgement of the community activities by the local government authority confirm the success and sustainability of the community-based composting projects.
Is the financial status and commercial value of the community-based composting projects favourable to sustainability and replicability?	To measure the financial sustainability and commercial viability of the composting project to run in a cost covering proposition.	The cost of the composting projects is covered by the revenues of collection fees and sale of compost product. In addition, the landfill savings are sometimes considered in the financial calculations to look into the commercial viability of the projects.
What is the present trend of organic compost production	To find out the existing compost supply-demand	Lack of demand and marketing capacity can undermine the potential

<p>and consumption? Is knowledge available to the end-users regarding the benefits and use of compost? What are the factors likely to affect the demand and marketing of compost? What marketing strategies are taken for the sale of compost and how do they influence the sustainability and replicability of the composting project?</p>	<p>scenario and to measure the awareness, attitude, preferences and purchase intension of the end-users for demand quantification and its likely development. To investigate the present demand and marketing limitations and find out which prospective marketing strategies led to maximum sales.</p>	<p>of composting as a suitable waste disposal option. Without creating effective marketing outlets or channels, composting plants may be another form of dumping and a waste for money.</p>
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3.6 Research strategy design

Generally research design means a plan or protocol for conducting a study through a sequence of steps from problem identification to the development of theory or conclusions. Research design is a reflexive process of events, a sequential model which links the activities of collecting and analysing data, developing and modifying theory, elaborating or refocusing the research questions, identifying and eliminating validity threats and ultimately reaching a series of results or conclusions (Maxwell 1996; Yin 1994). Maxwell (1996) characterised the research design with five key components through an interactive model:



- Purposes – What are the ultimate goals of the study? What are the issues and what are the factors to influence it? What is the worth of the study?
- Conceptual context – What are the existing theories or knowledge settings for addressing the proposed study?

- Research questions – What are the questions the research attempts to answer and how the questions are related to one another?
- Methods – What approaches and techniques will be used to collect and analyze the data?
- Validity – What are the explanations or evidences to support the research paradigm?

3.6.1 Choice of research design

Research is a systematic, planned activity which follows a logical way, moving step by step thinking through the aims to be achieved. So the choice of the research designs needs to be carefully planned in order to develop the best means of data collection and analysis. Yin (1994) offers guidelines which are useful in deciding the choice of strategy appropriate to the research questions posed (Table 3.3)

Table 3.3 Research design selection criteria					
Strategy	Case study	Survey	Archival analysis	History	Experiment
Form of research question	how, why?	who, what, where, how many, how much?	who, what, where, how many, how much?	how, why?	how, why?
Control over behavioural events	no	no	no	no	yes
Focus on contemporary events	yes	yes	yes/no	no	yes

He explained that the choice of research strategy should depend on three conditions, namely (a) the type of research question posed (b) control over behavioural events and (c) the degree of focus on contemporary events. According to Table 3.3 the “how?” and “why?” forms of research questions are tackled by experiment, history and case study. Experiments have control over the events that have to be looked into. History has no control over events as it occurred in the distant past. In this situation, the researcher has to depend on primary or secondary documents and cultural and physical artefacts as the main sources of evidence. In case studies, the researcher has to explain a contemporary event. Case studies employ techniques similar to those in history but add two additional sources of evidence – direct observation and systematic interviewing.

The research 'Sustainability and replication of community-based composting project' was a contemporary not a historical phenomenon where the problem definition and data collection were from existing natural settings. *'The research issue is a portrait of a particular social phenomenon, where a strong test of prevailing explanations and ideas already exists and the researcher need not exercise any control over the context'* (Maxwell 1996). In this consideration, historical, archival and experimental analyses were not feasible. The form of question could only provide the clue regarding the appropriate research strategy. In this research 'how?', 'what?' and 'why?' type questions were dominant, which directed the research techniques to case study, survey and some field observation. The primary research question (How sustainable and replicable are the community based composting projects for the management of solid waste in developing countries such as Bangladesh?) was of a 'how?' type. It was not possible for the researcher to exercise control over the projects as these projects were carried out by NGOs with the support and link of donor agencies. The cases involved on the contemporary events like solid waste management in the cities. In this research, a case study approach was the most appropriate research strategy. The case study approach is an empirical inquiry that examines contemporary events through conversing multiple sources of evidence or cross-referring what people say (interview), what we see them doing (direct observation) and what documents and records show (Gillham 2000; Yin 1994). Moreover, the case study approach focuses on a particular phenomenon in an in-depth account and builds their relationships in a natural setting which is more holistic and rounded than any other design approach (Denscombe 2001; Hakim 1997). Questionnaire surveys was also important in this research for getting reflection of actual choices, motivations, views, ideas of the community and the end-users of compost. Fig 3.1 gives an overview of the research strategy adopted in this case study.

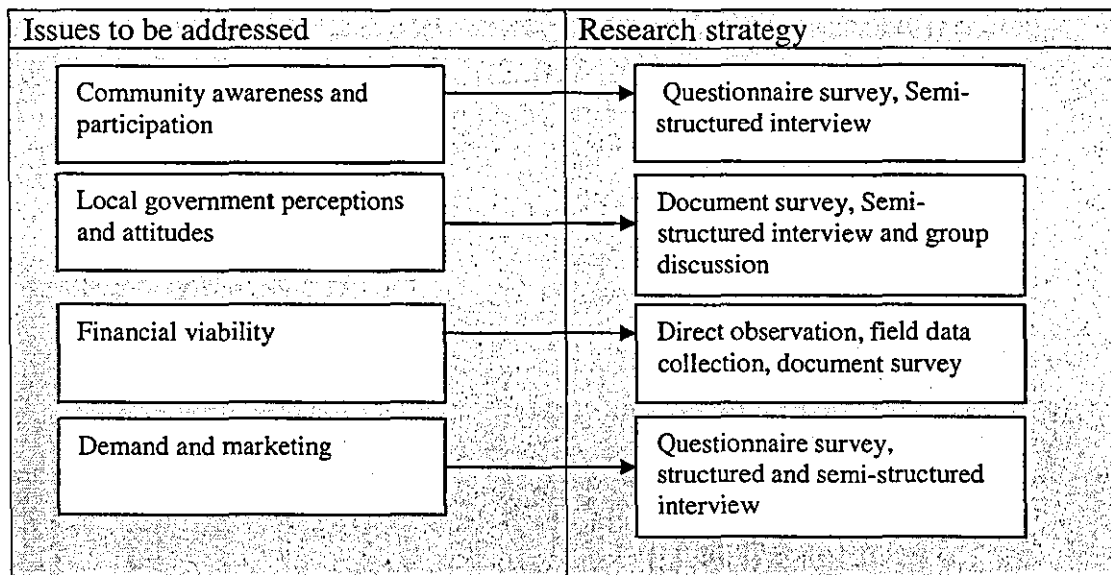


Fig 3.1 Overview of the research strategy

3.6.2 Validity and Reliability

The traditional prejudices against case studies are that the researcher may have the chance to be biased to influence the direction of the findings and conclusions (Yin 1994). To prove the credibility of the research, it is wise to justify the nature of the data collection techniques and the decisions taken during the research through certain logical tests. Yin (1994) and Oliver (1997) mention four types of criteria which can support the relative neutrality and unbiased role of the researcher:

- Construct validity: This is very much in the initial stage of the design process when the analytical frameworks are designed. It should be developed through a checklist mentioned by Denscombe(2001):
 - Does the research make suitable use of multiple methods?
 - Does the research consider the issue of generalisation from the design materials and the findings from the field work?
 - Do the research methods give a holistic perspective?

In this research, multiple data collection techniques were used to enhance the reliability and validity of the data. Data were collected in multiple ways: direct observation, semi-structured interview, questionnaire survey and group discussion. Findings were matched against similar cases for checking generalised potential.

- Internal validity: This is the process of establishing and comparing the data and information gathered from alternative sources in a chain of evidence.

In this research statistical test, especially cross-tabulation and correlation co-efficient were carried out to measure the cross-validity of the data.

- External validity: This is the process of developing a set of generalizations where the researcher compares and develops new generalized statements, from the findings of the fieldwork, with existing theories or explanations. It can establish how far the findings and conclusions fit with the existing knowledge on the area and how far they translate to other comparable situations.

Critics typically state that a single case study offers a poor basis for generalisation. In this research multiple cases were taken. The potentials and limitations of each case were thoroughly analysed to develop a generalised model which could be fitted for other cities in the developing countries with similar socio-economic and natural settings.

- Reliability: This means the research methods are neutral in their effect and would measure the same result when used in similar circumstances. The reliability may be ensured in this research through
 - Multiple sources of data
 - Triangulation of methods and their measures
 - Peer review of the questionnaires
 - Adoption of both qualitative and quantitative techniques

If a study is viable, if another investigator followed the same procedures, s/he would reach the same conclusions. Reliability may be threatened by the researcher's error or bias. It was minimised by collecting data from various stakeholders- community, end-users, CBOs/NGOs, local government officials and elected representatives. Different methods like surveys, interviews and direct observations were used to allow the researcher to view the topic from different perspectives and reach more complete and comprehensive findings. The questionnaires were peer reviewed and pre-tested before the final arrangement for surveys. Both the qualitative and quantitative data were analysed to reach a high degree of reliability.

3.6.2.1 Assumptions and Constraints

Some of the assumptions and constraints were addressed to carry out the research work. The constraints were overcome by taking some pragmatic steps without any interference in project activities.

Assumptions:

- The community role is vital in door-to-door waste collection services.
- Local government support is essential for the community-based composting project.
- Small-scale, labour intensive projects are better suited to the developing countries.
- There is a demand for organic fertiliser due to extensive use of chemical fertiliser and organic matter depletion in soil.

Constraints:

- Due to security problems, the households may not readily open the door to unknown persons. During the community household surveys, the community motivators and sometimes the waste collectors accompanied the survey team and gave an initial orientation that might have caused the households to feel unable to answer the questionnaire in front of the NGO representatives. This was overcome by the interviewers taking the leading role and telling them the purpose of the study.
- The housewives and the maid-servants are the main actors in house-hold waste management. Due to some restrictions in the Muslim religion, the housewives or maidservants were not entitled to give interviews. This was overcome by taking one woman interviewer in the survey team. It was found that a considerable number of housewives participated in the interviews.
- The households selected for the survey were within a distance of 500 m. This was done intentionally to ascertain the opinions of the community residents about the odour or other hazards for siting a compost facility in the community. This restricted the number of participants in the interviews.
- Scarcity of documentation, lack of information and transparency in financial figures were the limitations of data collection in most of the composting projects. However, during the field work, the plant managers were co-

operative and shared the information despite the management being reluctant to share the financial accounts.

- The programme was known to the researcher and he was the co-ordinator of the programme from the local government side. This might have caused some unintentional bias. However, the research was designed in such a way as to make the researcher independent of the activities and reduce the chance of providing biased information.

3.6.2 2 Justification for multiple case studies

This research was based on multiple case studies of four composting projects in three different cities. For justification of the multiple case studies, the researcher had to address the following questions (Denscombe 2001):

- How representative are the cases?
- Are the findings likely to apply elsewhere?
- How will they be generalised?

The advantage of selecting multiple cases is the facilitation of comparison and contrast of different cases, and securing confidence in the generalisation of the results to achieve replication (Hakim 1997). Multiple case studies were appropriate as the research involves too many actors to be addressed by interviews with their different roles, interactions, conflicts, beliefs and views. Every case has its advantages and limitations and from a learning process the key issues can be shared and designed for a generalised model for further replication. In this research, the main aim was to evaluate the sustainability and replication of community-based composting projects through the key measures of the community role, local government attitude, the financial state of the project, and the demand assessment and marketing techniques of the product. The cases selected for this research were of the waste problem solution from low income communities to high income communities where ownership, contribution, awareness and other internal and external complexities were identified and accommodated for generalisation. The cases were representative, replicable and fit for generalisation.

3.7 Data collection methods

This research started with an exploratory process after three months of literature review carried out as field work in Bangladesh from February 2003 to April 2003. The main purpose of the exploratory phase was to get an overall idea of the existing solid waste composting processes, the demand and marketing of compost, the existing policies and legislation for compost promotion, and the activities and prospect of organic fertiliser in Bangladesh. From electronic sources, information was obtained on composting projects operated only in Dhaka city. During this phase the researcher first visited the Bangladesh Agriculture Research Council, Waste Concern, a local NGO dealing with waste recycling, and the Bangladesh Fertiliser Association to develop a database on organic fertiliser manufacturers and users. In the first phase, the researcher visited more than ten organic fertiliser companies and interviewed them about their mode of operation, capacity, financial and marketing aspects. The researcher visited organic fertiliser users and a few farmers and dealers to get acquainted with the demand and prospect of compost in Bangladesh. From the exploratory phase, the researcher found that composting projects in Bangladesh were all at a pilot stage and operated on a small-scale in the community. The researcher found that the community-based composting projects were mostly donor supported and the local government authorities were running out of landfill spaces around the cities. In these circumstances, the sustainability and replication of the composting projects for the reduction and management of city solid waste would be a demanding issue for the decision makers.

To measure the sustainability issues of the community-based composting, the researcher selected four cases in three cities of Bangladesh. As this research is based on case studies, a multi-method approach was considered to be the most appropriate way to address the research questions posed. The second phase of data collection in the field was from November 2003 to May 2004 that included:

- Direct field observation
- Community house-hold and end-users questionnaire survey
- Structured and Semi-structured interviews
- Group discussions

3.7.1 Direct field observation

Observation is the direct evidence of the eye witness which permits measurement of actual behaviour rather than reports of intended behaviour. Observation is an exploratory technique which allows physical verification of the information gathered from reports and interviews so it has no chance of bias. Observation has the scope to examine cross-validity of different kinds of evidence that includes (Gillham 2000):

- watching what people do
- listening to what they say
- sometimes asking them clarifying questions.

One of the objectives of the research was to investigate the financial viability and operational performance of the composting processes. The researcher visited three composting plants in Dhaka, two in Khulna and one in Sylhet and made two kinds of observation:

Descriptive observation – This approach was flexible in nature and involved largely informal information collection for objective judgement. This includes:

- informal discussion with plant managers and workers
- the settings, the general picture of what is in the field
- some field records from the plants
 - Characteristics and quantity of feed stock materials
 - Monitoring sheet for collection of waste.
 - Temperature recording chart
 - Statement of compost production and sale,
 - Household and fee collection statement
 - Financial statements
 - Test report of compost

Field notes were taken with some pictures of the different processes of the composting plants.

Structured observation- This was formal and disciplined and yielded useful quantitative data. A structured form of systematic recording of data of the process activities and material flow from input to final product, and man-hour monitoring was supplied to the plant managers which was responded to after two weeks except in the latter steps of the composting process [Appendix-A]. The detailed schedule of field observation of the composting plants:

Location	Date	Plant manager/ Accompanying person
Dhalpur composting plant, Dhaka	20.11.03	Mr. Jafar Ahmed
Mirpur composting plant, Dhaka	21.11.03	Mr. Jubelli
Barrel type composting in Slums, Dhaka	25.11.03	Mr. Jubelli Mrs Lucky
Sylhet partnership company composting plant, Sylhet	28.11.03	Mr. Uttam Kumar Saha
Plant No. 1 Prism-Shomas Progoti Sangsta (SPS) composting plant, Boira Khulna	20.03.04	Mr. Milon Mr. Munir Alam Chowdhury Mr. Sharif Mondal
Plant No. 2 Prism- Sobujsona Composting plant, Khalispur, Khulna	20. 03.04	Mr. Prosanto Mr. Munir Alam Chowdhury Mr. Sharif Mondal
Compost Packaging Centre Khalispur Housing Estate, Khulna	20.03.04	Mr. Munir Alam Chowdhury Mr. Sakib

3.7.2 Community household and end-users questionnaire survey

The community households and the end-users of compost are the essential part of the composting project at two ends. Community households are the residents in the community who are involved in delivering waste and paying charges for collection. The end-users are the farmers, nurseries and other potential users who demand and use the compost. These two groups are large, and obtaining their opinion through standardized questionnaires may facilitate comparability of data, and accuracy of recording and effective data processing. A questionnaire survey provides factual information, opinions, attitudes, views, beliefs, preferences and expresses values (Denscombe 2001).

In this research, two questionnaires were developed, one for the community members who had been participating in the community-based collection and the other for the end-users of the compost. The questionnaires were developed, discussed and revised through conducting a pilot survey with six community members (two from each community) and three farmers in the Hamayetput, Savar near Dhaka during the exploratory phase of the field work. With the help and collaboration from a senior research officer of Waste Concern and a project officer of the Integrated Soil Fertility and Fertiliser Management Project of the Department of Agriculture Extension, who had experience in questionnaire surveys, the questionnaires were further reviewed and finalised. The questions were prepared in Bengali (local) language for easy

communication with the interviewees and so as to avoid misinterpretation by the interviewers from translation.

3.7.2.1 Community household survey

In Dhaka, community household surveys were conducted in four areas where Waste Concern established composting activities in the community. The community household surveys were not conducted in Khulna and Sylhet because the questionnaire did not fit the physical setting of the areas.

The objective of the community household survey was to ascertain their awareness and participation level in the composting process, to understand their attitude towards participation in waste separation and willingness to pay for compost. The questionnaire included:

- Socio-economic data (Household size , income), consumption pattern and quantity of waste generation
- Environmental awareness and concern for managing waste
- Knowledge and views about composting
- Perception and desire of waste segregation
- Level of participation of the community in the project
- Willingness to pay for composting.

These issues were covered in an attempt to assess the community awareness, ownership and contribution towards the waste composting.

In this research, 165 community households were surveyed (50 from Dhalpur, 50 from Mirpur, 50 from Green road and 15 from Baily road). Although in these areas large numbers of households were participating in waste collection activities, the sample households for interviewing were selected from the communities close to the composting plants to measure the acceptability with regard to nuisance and hazards in the facility. The questionnaire for household survey in Baily road was slightly different because the composting operation of this plant was stopped due to objections raised by the residents of the nearby building. Another survey was conducted in two slums (Shah Ali Bagh slum 30 households and in Nasimbagh slum 30 households) where barrel type composting was in operation under Waste Concern's technical assistance. The English translated copies of the households survey questionnaires are

given in the Appendix-B1, B2 and B3. A summary of the household surveyed is presented in the following Table 3.4:

Table 3.4 Summary of the households surveyed through questionnaire		
Plant Location	No. of households participated in waste collection (Sample surveyed)	Criteria for sample selection
Dhalpur	Golap bagh – 50 (16) Staff quarter- 135 (15) East Maniknagar – 105 Maniknagar – 150 (19) Total – 440 (50)	The samples were taken from the households residing within 500 m. In staff quarters, 3 from each building were taken, and in Golapbagh and Maniknagar alternate houses specially the landowners (if resides in the building) were given preferences.
Mirpur	Road No.D- 390 (24) Road No. E – 260 (13) Road No. F- 260 (13) Total - 910 (50)	The samples were taken from the households residing within 500 m. The households were considered from the nearest distance to further.
Green road	Building No. 1 – 36 (9) Building No. 2 - 36 (22) Building No. 10 – 36 (5) Building No. 17 – 36 (7) Building No. 18 – 36 (7) Other Buildings – 363 (0) Total – 543 (50)	The households from where samples taken were within 500 m. The nearest buildings were considered and flats were selected on an alternate basis.
Baily Road	*Building No. 15 - 36(15) Other Building – 264 (0)	* Composting plant is located just behind the building and samples were mostly taken from the closest flats.

Layout plans of each area were collected and a combined visit was made with the community officers whose normal role was to motivate households and collect fees. For the assistance in surveys, in each area three persons were involved (community officer of the compost plants and two social science post graduate student (one male and one female) from Dhaka University)). In each place, the researcher joined the team as an observer and talked to the people to understand the attitude and opinions of the residents. It also provided the residents with an opportunity to express their thoughts and views on the project. Prior to data collection, the survey team were given an orientation on the purpose of the research, the type of data sought and the methods of administering the survey and how to record the responses.

Surveyors preferred every afternoon or morning in the holidays (two hours) and in each area the survey took three days to complete. If the households were not interested in giving their time, the next household was approached.

In Baily Road, the researcher took his niece who resides in the next building and knew the activities of composting. As the case was sensitive because of the closure of composting activity, the researcher participated by himself in the survey.

In Shah Ali bagh and Nasimbagh slums, the researcher was helped by the community officer of Waste Concern, who had worked in the slums from the beginning and was well acquainted with the slum dwellers.

3.7.2.2 End-users survey

In this research, two types of farmers were surveyed: one type of farmer who used waste derived compost and the other type of farmer who did not use waste derived compost.

In Mirershari (190 km from Dhaka) 20 farmers and Fatikchari (280 km from Dhaka) 16 farmers who used waste derived compost were interviewed. The farmers were selected from the procurement list given by the compost dealers.

In peri-urban areas [Shampur (25 km from Dhaka city), Munshigonj (50 km from Dhaka city) and Rajbari (25 km from Khulna city)] the farmers (20 from each area) were selected with the help of block supervisors of the Agriculture Extension Department who held information on the farmers of different land holds and ownership patterns.

In Dhaka City, there were more than two hundreds big nurseries (in the network of Bangladesh Nursery Owners' Association), out of them 20 nurseries were surveyed. The location of the nurseries was identified from discussion with the Chairman of the association and they were contacted through the snowball method, starting with a well-known nursery and following up connection.

The objective of the questionnaire survey was to measure the awareness, attitude, preferences, purchase intension, ability and willingness, and to determine the demand quantification and its likely market development. The questionnaire developed for the survey prior was reviewed and revised following the discussion with project officer of Agriculture Extension Department. A pilot test was carried out on three farmers and improved based on the results of the pre-testing. The questionnaires were based on the following issues:

- Land ownership, amount of land under fertiliser use, types of cultivated lands
- Amount and type of fertilisers use
- Awareness about compost and source of information received
- Benefits and problems of compost use
- Locally available organic inputs

- Present use and future demand
- Price willing to pay

The questionnaire was in Bengali and translated into English, and is given in the Appendix-B4 and B5.

The questionnaire survey team comprised of one graduate student of Patuakhali Agriculture College accompanied by the representative from compost dealer of Mirershari and Fatikchari. In Mirershari and Fatikchari, the researcher carried out structured interviews with the compost dealers to ascertain the opinions of the farmers and the demand. This information was cross-checked by the researcher by interviewing the farmers. In Shampur and Munshigonj, the researcher accompanied the agriculture graduate. In Khulna, the survey team was accompanied by the marketing officer of Prism.

For the nursery survey, the researcher accompanied the agriculture graduate. Each of the surveys took whole two days to complete excluding the journey.

Response and error from questionnaire surveys

The reliability and validity issues with regard to the data collection by questionnaire-based surveys depend on mitigation of errors or bias in the surveys.

- Sample selection bias – The samples selected for community household surveys were totally based on the distances (within 500m) from the composting plants. In the case of flat houses, every alternate flat was taken and in other residential settings, home owners and renters were both considered in interviews. In the case of farmer surveys, the farmers who used waste derived compost were taken from fertiliser dealers and in the peri-urban areas sample of farmers were selected in consultation with the block supervisors who had information about farmers of different categories and land ownership.
- Non response error – The questionnaires were designed in a very simple way and the interviewers were given an orientation about the structure of the questionnaire and how to record the responses. From the frequency analysis the missing values were found to be negligible, with only about 10% in two questions such as income level.
- Response error – The questionnaires were translated into local language for ease of understanding of the respondents. The survey team were provided with

a detailed orientation on the purpose of the study as well as clarification of each point of the questionnaires. The survey team comprised experienced personnel who had previous knowledge on this subject.

3.7.3 Interviews

Interviews are the essential source of case study evidence where the events are reported and interpreted by the direct presence of the interviewee and interviewer and allow a straight forward approach of finding things out (Robson 1993; Yin 1994).

Three types of interview were conducted for this research:

- Unstructured interview
- Semi-structured interview
- Structured interview

3.7.3.1 Unstructured interview

This was conducted at the exploratory phase of the research to gain an insight into the area of research interest. Sometimes this type of interview was followed by observation in the field. When the researcher visited different composting plants and organic fertiliser factories around Bangladesh, the plant operators and workers were interviewed informally and allowed to talk about their views and perceptions in their own capacity to get insight into the research issues. All the questions were open-ended to capture the broadest possible viewpoints. Field notes were taken by the researcher at the time or soon after.

3.7.3.2 Semi-structured interview

This form of interview helps the interviewee to speak more widely on the research area in an open-ended and conversational manner where the interviewer is more likely to control the interview within a certain set of questions (Yin 1994; Denscombe 2001). The questions were predetermined with some being closed and others open-ended. Semi-structured interviews were conducted with the key personnel who were in a position to know about things, or highly experienced personnel with a high degree of responsibility. In this research, interviews were carried out with informants from the city authorities, local commissioners, community leaders, project managers,

organic fertiliser producers and marketers, landscaper and nursery representatives, donors and CBOs representatives. Appointments were made with the key informants. Prior to the interviews, the interviewees were informed about:

- The purpose of interview and research objectives
- The estimated length of interview
- Confidentiality

A checklist was prepared to guide the interviews. It was built around the research questions and indicators. All the interviewees were responded to in the local language to allow them to feel free to express their views, and notes were taken in brief (bullet points) during the interview. At the end of the interviews, a summary of the discussions was made to seek confirmation (agreed /disagreed with the records) from the interviewees. The interviews usually lasted between 45 minutes and 1 hour. Immediately after the interviews or on the same day, the detail interview wordings were recorded as a transcript in English. In some cases, if e-mail facilities were available, feedback and clarification was taken from the interviewees. Some of the excerpts from the interview transcript were quoted or used in explanation building. Some of the sample interview transcripts are presented in Appendix D.

The respondents did not always give direct answers, but gave a wealth of information around the queries. Recording devices were avoided because it might inhibit to spontaneous conversation, and might create an artificial situation. As a result respondents have felt relax or open to answer.

Details of the key informants interviewed together with position and organization are listed below. The excerpts from the interview transcripts of the highlighted key informants were used in the analysis in this thesis.

Key informants interviewed			
No.	Name	Position and organization	Main issues of interview
1.	Commander Sohel Farukee	Chief conservancy officer, Dhaka City Corporation	Views on community initiatives
2.	Mehdi Ali Khan	Additional Chief Engineer, Dhaka City Corporation	Demand and use of compost in city plantation
3	Akhteruzzam khan	Chief Slum Development Officer, Dhaka City Corporation	Impacts of barrel type composting in slums
4	Md. Afzal Hossain	Chief Arboriculture officer , Public works department	Demand and use of compost in parks and gardens

5	Seikh Mizanur Rahman	Assistant Chief Conservator, Department of Forest	Demand and use of compost in forestry
6	Munshi Bazlur Basid Anju	Ward Commissioner, Ward No. 2 (Mirpur), Dhaka City Corporation	Impact of composting in city cleanliness and their political commitment to support community initiatives
7	Md. Badal Sarder	Ward Commissioner, Ward No. 85 (Dhalpur), Dhaka City corporation	Impact of composting in city cleanliness and their political commitment to support community initiatives
8	A.B. M. Badsha	Ward Commissioner, Ward No. 30 (Maniknagar), Dhaka City Corporation	Impact of composting in city cleanliness and their political commitment to support community initiatives
9	Md. Abdul Latif	Ward Commissioner , Ward No. 51 (Green road), Dhaka City Corporation	Impact of composting in city cleanliness and their political commitment to support community initiatives
10	Mr. Abdul Baset	General Secretary , Mirpur-2, Household Welfare Association	Participation and impact of community initiatives
11	Nurul Haq	General Secretary, Green Road Staff Quarter Welfare Association	Participation and impact of community initiatives
12	Sarder Kaiser	President ,DCC Staff Quarter Welfare Association, Dhalpur	Participation and impact of community initiatives
13	Mahfuzul Haq Juglul	Managing Director, Interdec Ltd. Landscape Architect	Potential use of compost in landscaping
14	M A Hakim	Chairman , Bangladesh Nursery Owners' Association	Potential use of compost in nurseries
15	Mr. Kafiluddin	Chairman , Bangladesh Fertiliser Association	Prospect of organic fertiliser
16	Mr. Hakimuddin	Sub-Assistant Engineer, Public Works Department, Green Road	Collaboration and support to composting
17	Safiul Azam Ahmed	Water & sanitation Specialist, WSP, World Bank, Dhaka Office	Views on sustainability and replication of donor funded projects
18	Afrosa Ahmed	Project Officer, UNICEF Dhaka Office	Views on sustainability and replication of donor funded projects
19	Iftekhhar Uddin Tanvir	Senior Research Officer, Waste Concern	Compost production and its prospect
20	Monir Alam Choudhury,	Project Co-ordinator, Prism Bangladesh	Compost production and marketing
21	Uttam Kumar Saha	Chief Executive Officer, Sylhet Partnership Company	Compost production and marketing
22	Md. Rafiqul Islam	Research & Project manager Alpha Agro Ltd.	Marketing strategy of compost
23	M. Omar Faruk	Managing Director Faruk Fertilisers Ltd.	Production, demand and marketing of organic fertiliser
24	Afzal Hossain Bhuiyan	Programme Co-ordinator Proshika Manobik Unnayan Kendra	Demand of organic fertiliser and organic farming

25	Prof. Dr. Syed Safiullah	Bangladesh Environmental Products & management Ltd	Production, demand and marketing of organic fertiliser
26	Md. Amirul Islam	Assistant General Manager Aftab Fertilisers & Chemicals Ltd.	Production, demand and marketing of organic fertiliser
27	Farida Akhter	Chairperson UBINIG- A NGO for Organic movement	Prospect of organic fertiliser and organic food
28	Md. Rakibul Bari	Social Forestry Specialist Bangladesh Rural Advancement Committee (BRAC)	Prospect of organic fertiliser and organic food
29	Hasibur Rahman	Executive Director ACME Laboratories	Prospect of compost use in crop cultivation
30	Durlop Roy	Agronomist Northern Agro Ltd.	Production, demand and marketing of organic fertiliser
31	Iftekhar Enayetullah	Director Waste Concern	Compost production and use
32	Mr Jubilee	Project Manager Waste Concern	Composting in slums
33	Md Nurul Huda	President, Bangladesh Integrated Environmental Development Forum	Community initiatives , experience on private sector participation
34	Md. Liakat Ali	Chief Engineer, Khulna City Corporation	Demand and use of compost in city
35	Md. A. Sattar	Chief Conservancy officer, Khulna City Corporation	Views on community initiatives

3.7.3.3 Structured interview

In this type of interview the researcher attempts to control the interview through asking predetermined set questions and the responses are recorded on a standardized format of answers. Each respondent has to answer the same questions and this establishes the neutrality of the interviewer's role (May 1997; Robson 1993). In this research, structured interviews were conducted with the compost dealers. The dealers' names and addresses were collected from the compost manufacturers. The main purpose of the interview was to understand the prospects and limitations of compost sale. The interview questionnaire is given in Appendix C.

3.7.4 Group Discussion

Group discussion involves respondents more or less of the same status and helps to reveal consensus views. It may generate richer responses by allowing participants to interact with each other discussing the topic of concern with the guidance of the researcher (Gillham 2000; Denscombe 2001). In this research, group discussions were

held with the conservancy officers (8 to 10 participants) of two Zone offices of Dhaka City Corporation, where two composting plants were located. The conservancy officers are responsible for the day to day waste management in their designated areas. Their views and opinions would reflect the actual situation and their interactions with the community initiatives. The objective of the group discussion was to find out the awareness, attitude and level of satisfaction or dissatisfaction of the municipal conservancy officers regarding the community waste collection and composting projects from city solid waste, their attitude towards linkage or acknowledgement of the community collection and composting activity, their ideas about volume reduction by recycling of waste. In the group discussions the following issues were discussed:

- General awareness and knowledge of the municipal officers about waste disposal.
- Attitude, level of satisfaction or dissatisfaction with community collection and composting activity.
- Ideas about waste reduction or recycling.
- Attitude towards co-operation with the community initiatives and their acknowledgement in the mainstream of municipal waste management.

3.7.5 Documents and Reports

Systematic searches of relevant documents are important in any data collection plan which provides background information as a source of secondary data. The project activities were not systematically documented and presented. The costs, expenditures and financial matters were not well recorded and transparent. Some policy documents and local literatures on waste management were available but their content was not very detailed.

3.8 Summary of the research methods

This research is rich in both qualitative and quantitative data generation and compilation relating to the community-based composting projects. The summarised database of the different research techniques applied in this research is presented below:

Summary of the research database	
Research Methods	Category
Questionnaire Survey	<ul style="list-style-type: none"> • Community household surveys • End-users survey <ul style="list-style-type: none"> - Farmers who used compost - Peri-urban farmers - Nurseries
Structured interview	<ul style="list-style-type: none"> • Compost dealers
Semi-structured interview	<ul style="list-style-type: none"> • City Authorities • Local Ward Commissioners • Project managers • Community leaders • Donors • Compost distributor • Organic fertiliser manufacturers • Landscaper and Nursery owners
Direct observation of composting facility	<ul style="list-style-type: none"> • Community composting plant at Dhalpur, Dhaka (Waste Concern) • Community composting plant at Mirpur, Dhaka (Waste Concern) • Barrel composting in slums at Dhaka (Waste Concern) • Community compost plant at Khulna (Prism) • Community composting plant at Sylhet (Sylhet partnership company)
Documents and Records	<ul style="list-style-type: none"> • Dhaka City Corporation Municipal Ordinance' 1983 • Bangladesh Environmental Conservation Act' 1995 • National Water Supply and Sanitation Policy ' 1998 • National Agriculture Policy' 1999 • Project report of Integrated Soil Fertility and Fertiliser Management project (2002-2003), Department Of Agriculture Extension • Project reports of Waste Concern, Prism and Sylhet Partnership Company.

Six data collection tools were used in this research: Questionnaire survey, structured and semi-structured interviews, group discussions, document and reports survey and direct observation. A summary of the database in quantity is presented below:

Summary of the research database	
Research methods	Quantity
Questionnaire surveys	401 [Community survey-165 Slum dwellers-120 Farmers who used compost-36 Peri-urban farmers-60 Nursery-20]
Structured interviews	7
Semi-structured interview	35

Group discussions	15 in two groups
Documents and Reports	8
Direct observation of composting facility	5

3.9 Data Analysis

The data obtained in this study were both qualitative and quantitative in nature. Quantitative data were generated from the surveys and direct observation in the field. The survey data were sorted entered into computer as numerical codes and analysed using Statistical Package for Social Scientist (SPSS) software (SPSS for Windows, Release 11.0). The methods used for analysis of numerical data were:

Descriptive statistics- These included frequencies, measure of central tendency, cross-tabulation, ranking to find the percentage of responses and measures of variations.

Significance of relationships – A Pearson Chi-square test was used to measure the relationship between variable at 95 % significance. Correlation co-efficient by Linear Regression was done to test the degree of relationship between two variables.

Quantitative data gathered from the direct observation were used to calculate:

- The investment and operational cost of the composting plants
- The cost reduction of transportation and disposal by composting
- The dumping area saved, reduction of landfill cost
- The Net Present Value
- The cost recovery from revenues
- The commercial value of compost and other alternatives compared to chemical fertiliser on price and nutrient basis.

Qualitative research is an information gathering exercise or can be used as the basis for generating theories. Qualitative data generated from semi-structured interviews with key informants and observational reports of different composting facilities were organised by using the software ATLAS. ti 4.2. This software was used for organising a structure of the transcripts with key variables and revealed links for content analysis by:

- Storage of data – Interview transcripts, field notes and documents in rich text format.
- Coding of data- Indexing the data for reference purposes by the indicators

- Retrieval of data – The search facilities of the software make it easy to locate data once it has been coded.

3.10 Indicators

The main aim of the research was to examine the sustainability and replication of community-based composting projects where the community participation, local government attitude, financial viability, and demand and marketing issues are considered as the main aspects for developing a model for further replication and a city wide solution. In connection with the different aspects, the following indicators were selected to probe the hypothesis (Table 3.5).

Table 3.5 Key aspects and indicators for sustainability and replication of community based composting project		
Key aspects	Indicators	Purpose
Community awareness and participation	Community motivation and attitude	To look into the behavioural changes of community members from just throw attitude to co-operation and participation in waste segregation, storage and disposal of waste.
	Community acceptability	To observe the concern and attitude of community members for siting compost facility close to community.
	Community ownership	To measure the responsiveness and level of participation of the community members.
	Community contribution	To measure the support of the community members by willingness to pay for composting and representation in project committees.
Local Government perceptions and attitudes	Municipal officials' awareness and attitude	To look into the idea and level of satisfaction of municipal officers about community based waste collection and recycling activities. To measure the support and acknowledgement of the community based activities and willingness and intention to incorporate them into the mainstream of formal solid waste management.
	Political will	To entail political decisions to extent support to community based activities and give them

		recognition.
	Policy and legislation	To observe the policy and legislation of the government related to waste reduction and recycling.
Financial viability	Capital and operational cost	To examine the costs to make a comparison between the existing waste management cost and the cost of composting, whether composting is financially attractive or not than landfill disposal.
	Revenue and cost savings	To determine the earnings from the revenues of the composting projects can offset the cost of composting.
	Commercial value of the composting projects	Though community based composting projects are not set up for commercial purposes but the commercial implication of the project may assess its strength as business entity.
Demand and marketing	Present status of compost production and consumption	To observe the supply-demand scenario of compost for sustaining the activities of the composting project.
	Knowledge and awareness of potential users	To determine the knowledge and information level of the end-users about waste derived compost.
	Factors constraining compost demand and marketing	To examine how the factors such as agricultural practices and land ownership pattern, product quality and safety, availability and price of the alternative products, and legislative, technical and cultural barriers influence the demand and marketing of compost.
	Marketing strategies	To evaluate the effective marketing strategies for compost promotion and delivery.

3.11 Lessons learned from the fieldwork and future implication

The research was based on direct field observation, questionnaire surveys, interviews and group discussions. Both the qualitative and quantitative data were collected from the field. It was not always possible to adhere to the intended data collection procedures in practice. Some modifications and alternative procedures were followed

during data collection. Some notable experiences and adaptations are explained below:

- One of the objectives of the research was to investigate the financial viability and operational performance of the composting projects. In most cases, it was found that the management was reluctant to share the financial data or in some cases the data were poorly recorded. In these cases, the plant managers were provided with a structured form for systematically recording the data of the composting projects with some financial incentives.
- During the community household questionnaire survey, the representatives of the projects concerned were taken to accompany the survey team. This was to overcome the problem of households not feeling comfortable talking to or opening the door to unknown persons for security reason. However, the presence of the NGO representatives was viewed as being likely to affect how free the households felt to talk in front of the NGO representatives. This was overcome by the interviewers taking the leading role and telling the households about the purpose of the survey.
- The housewives or the maidservants who dealt with kitchen waste were encouraged to take part in the interviews. For religious reasons, the housewives were not accustomed to giving interviews to male persons. This was overcome by taking a woman interviewer in the survey team.
- The community household survey was intentionally restricted within a distance of 500 m of the composting facility so as to obtain the opinion on the odour or other hazards for siting composting facilities in the community. This limited the number of participants in the interview.
- For authenticity of recording interviews, it is helpful to use a tape-recorder. However, it was found that the interviewees felt free to express their views in local language rather than English. In addition, they were not used to having their views recorded and it was felt this would reduce spontaneity in the interview. To avoid the formal environment, interviews were taken in Bengali language and after the interviews the detailed transcripts were written and translated into English.
- In the group discussion, it is usually found that the leader of the group is always vocal and the sub-ordinates are not feeling free to talk in front of their

senior officers. To overcome this situation, attempts were made to ascertain the opinion of each participant.

The fieldwork was carried out smoothly with no serious difficulty. During the field work most of the projects were in the initial stages. However, from the experiences gained in the fieldwork, the following research methodology or strategy could be adjusted as follows if a similar study is carried out in the future.

- A focus group discussion could be arranged with the participation of all stakeholders including the funding agencies. In this discussion, the experiences and views of the beneficiaries could be given priority over the formal presentation of the project initiators.
- To ascertain willingness to pay for the service or product, a contingency valuation method could be applied to get the actual reflections of the respondents.
- From socio-economic data, income level could be set out and targeted residents of different income groups could be interviewed to find out their interests in participation.
- For the demand quantification of waste-derived compost, the agriculture ministry and the associated departments could be targeted for interviews.
- The interviews with waste workers could be arranged to ascertain their willingness to carry out the composting activities in future.
- Some interviews could be taken with the micro-enterprises to know their interest in the composting project.
- Some pilot-scale source separation practice could be arranged as part of the study and then willingness to participate and responses could be assessed.

3.12 Summary

This chapter explained the methods used in this study to investigate the sustainability and replication of community-based composting projects. The research investigation started with an exploratory phase to verify the existence and nature of the composting projects. The particular aim of the research was to provide decision-makers with a sustainable and replicable composting model for the solution of waste disposal problem in the cities. The research encompassed a variety of issues including

community awareness and participation, local government perceptions and attitudes, financial viability and compost demand and marketing. Two underlying issues of the hypothesis were the prime considerations: one was the present stage of development and the other was sustainability and replication. The research was based on multiple cases to facilitate generalisation from the equalities and contrasts.

This research design was based on case studies which were supplemented by both primary and secondary data sources. For the primary data sources the researcher relied on household community and end users survey, structured and semi-structured interviews with key informants, direct observations and group discussions. The secondary data sources relied on policy documents and project reports, academic journals and books, electronic sources for ready reference to enrich the research with data and explanation building.

Significant effort was made to ensure the reliability and validity of data. The findings from the different methods and data sources were triangulated for validity of the research. The research was rich in both qualitative and quantitative data. The quantitative data were analysed using SPSS software to establish correlation among the variables. For the qualitative data Atlas.ti 4.2 software was used for coding the data and retrieved to build an explanation for generalisation and conclusion.

Chapter 4

Overview of Community-Based Solid Waste Management in Bangladesh

4.1 Introduction

This chapter gives an overview of community-based solid waste management in Bangladesh. The first part of this chapter describes the history and development of different initiatives in support of community participation. This is followed by a description of the roles of different organisations in community-based waste management activities. The participation of the local governments and their legal and institutional roles are described; this is essential for sustainability of the community-based initiatives. The latter part of this chapter acquaints the readers with the background and activities of the community-based composting projects selected as case studies for this research. The chapter concludes that in the cities of Bangladesh, community-based composting projects are developed on an experimental basis in collaboration with external support agencies. To look into sustainability and replication of the projects, it is necessary to evaluate through the key aspects of community participation, local government attitude, financial situation, and the demand for and marketing of compost.

4.2 Development and status of community participation

Bangladesh has a rich history of local initiatives undertaken by individuals and groups. Civil societies in Bangladesh have been active and played an important and decisive role in the country's social, economic and political development (Islam and Mahjabeen 2003). Some of the highly innovative NGO initiatives of Grameen Bank, Bangladesh Rural Advancement Committee (BRAC), Proshika and Gonosastho Kendro in the field of micro-credit, women's empowerment, population control, health and primary education are regarded as successful development models around the world (White 1999; Lewis 1997). These models have provided inspiration for social clusters, self-help and contribution of people.

In the colonial period, some traditional self-contained and self-governed organisations were active in the villages and towns of Bangladesh. In the villages, the village

councils were composed of respectable households who were empowered to govern decisions regarding matters of public interest and to administer justice (Siddique 1994). In the towns or urban settlements panchayet² composed of five elderly persons headed by a sardar (leader) governed the activities of the neighbourhoods. Panchayet was used to mediate disputes among the inhabitants by salish (settlement by local arbitration) and the decisions had to be accepted by the parties (Haider 1966). The panchayet system was discontinued following the partition of India in 1947, but in some parts of old Dhaka, the panchayet system is still operational. The panchayet system has now been replaced by the ward administration (lowest administrative tier of urban local government) headed by an elected ward commissioner who looks after the administrative, economic, quasi-judicial and development related matters of his/her respective ward.

Some kinds of formal and informal clustered participation³ in the name of shomity (association of neighbourhood) or welfare committees function in the cities. Their main activities are community security, garbage collection, road widening, sports and culture. Another type of community organisations that has been growing in the cities is the housing societies or co-operatives comprised of formal portfolios of president, secretary, treasurer, members etc. These societies are basically formed to look after the activities such as to ensure security and safety of the area, to resolve internal conflict among the members, to ease building construction in the area without external interventions (forced contribution) and to carry out activities of educational and religious institutions established by the societies. Waste collection programme has only recently gained priority in their activities.

Natural calamities such as floods, tidal waves and famines, occur quite often in Bangladesh, and this has paved the way for co-operation and voluntary efforts through relief and welfare, and self-help activities in the country. At a village level, community participation was very much in practice by the NGO led activities such as

² The panchayet system was originally introduced by the Chaukidari Act of 1880 in response to socio-cultural needs of the various mahallas (neighbourhoods). Panchayet maintained a local police force and carried out extra judicial role to maintain social harmony. It was more or less representative institution. Sardars were selected and patronaged by the Nawabs (landlords) and the members were selected from the elders and powerful people of the locality (Haider 1966).

³ Formal participation involves direct user contribution of financing, labour or material into a government sponsored infrastructure project. Informal participation involves user generated facilities that function more or less independently of the public facilities.

the CARE project on food for works. In the urban areas, UNICEF supported slum improvement programmes, WHO (World Health Organisation) sponsored healthy city programmes, ADB promoted primary health care projects, World Bank funded secondary town and urban basic services delivery programmes and these were all based on community participation and has been proven to be very effective in providing primary waste collection and disposal services (Islam and Shafi 2004).

Civil society groups and voluntary organisations have come forward to begin action to protect the environment of the cities. Such an organisation is BAPA⁴ (Bangladesh Poribesh Andolon) a pressure group for the protection and betterment of the environment in Bangladesh. Jotiya Sahitta Kendra (National Literary Centre) led by eminent professor Abdullah Abu Sayeed, the Hunger project, Bangladesh led by Dr. Badiul Alam Majumder are representing some of the forums of common people who come forward in the city cleanliness drives or other related civic problems.

The German Cultural Centre Goethe Institute, Dhaka was proactive in making the people conscious about environmental hazards. With the support of this institute, a group of language students formed a Task Force on the Environment in 1993, and volunteered to create awareness among the citizens with regard to disposal of household waste. Another initiative was undertaken by the well known theatre group Dhaka Little Theatre, who with support from the German Cultural Centre staged an open air drama on solid waste problems at some schools in Dhaka city (Lechner 1994).

The Daily Star (national newspaper), Bangladesh Scouts and Bangladesh University of Engineering and Technology (BUET) jointly organises rallies, workshops and round table dialogues under the caption 'Save Dhaka, Clean Dhaka', to raise public awareness and to motivate the policy makers.

Donor organisations such as the UNDP and the World Bank sponsored community-based management projects in Bangladesh. The UNDP sponsored Sustainable Environmental Management Programme (SEMP) - the follow-up implementation of

⁴ BAPA (Bangladesh Poribesh Andolon) is a common forum of citizens and organisations concern with the environment of Bangladesh. It first started as a community-based group named POROSH in 1997 and virtually transformed into BAPA in 2000. It holds rallies, demonstration to build up public awareness and secure wide participation of people on environmental issues. It often organises national and international conferences on health and environmental sensitive issues.

the National Environmental Management Action Plan (NEMAP)⁵, which enhanced community participation, protection of the environment and sustainable management of environmental resources. Community-based waste management was one of the main components of that programme. The World Bank's Municipal Service Project (MSP) provided a mix of grants and loans in the name of municipal development fund (1999-2005) to the class-1 municipalities and city corporations. The project supported water supply, drainage, sanitation, road development and solid waste management. The project components were implemented via community-based organisations on a capital cost recovery basis with special emphasis on sustainability, community empowerment and participatory community engagement.

In the late 1980s, a major change took place in the field of solid waste management. Communities started self-collection activities through door-to-door⁶ waste collection service (Box 4.1). Such community-based waste collection services first started in 1987 in the Kalabagan area of Dhaka city (Box 4.2). Following this pioneer door-to-door waste collection service, a large number of community-based initiatives [more than 130 in Dhaka city (Kazi 1999a), 14 in Khulna city (Chowdhury 2004), nearly 100 in Chittagong city (Bhuiyan 2004)] emerged across the country.

Box 4.1 Outline of the community-based solid waste collection service

In a community-based collection service, the rickshaw van travels a regular route at mostly the same time and stops in front of the residential holdings where a bell is sounded. Upon hearing the bell, households bring their refuse containers and hand them over to the crew, usually consisting of two men, which empties the container and returns them to the households. Organisers of the system collect fees from the households on a monthly basis to meet the operation and maintenance cost (Kazi 1999a).

Box 4.2 First community-based door-to-door solid waste collection initiative at Kalabagan, Dhaka

Mr Mahbub Ahsan Khurram, who had lived in Germany for some time, became frustrated with the unbearable situation in his living area scattered with foul smelling waste. To tackle the situation, he purchased two old rickshaws and turned them into waste carriers. He engaged a driver and an assistant, who blew a whistle to attract the attention of the households for delivering waste. He was able to convince the neighbours to pay a monthly service charge for operation and maintenance of the service (Yousuf 1996)

⁵ NEMAP was the first ever participatory plan developed over a period of five years through organisation of consultations at grassroots in 1996.

⁶ Door-to-door waste collection service means people deliver their waste from the door-step to a particular organisation or service and pay a service charge in exchange. In this thesis 'door-to-door' is synonymously used as house-to-house or primary waste collection service.

According to Yousuf (1998); Kazi (1999b), the reasons behind the start of the waste collection system by the community were:

- Municipal solid waste management system was unreliable and failed to collect waste on a regular basis.
- Communal bins⁷ were not available in some communities.
- If bins were available but were not placed at suitable locations; residents had to walk a distance with the waste.

Prior to the intervention of the community waste collection initiatives, the residents of the locality used to dump or throw their waste indiscriminately onto the streets or nearby low-lying areas. As a result, large quantities of waste accumulated and caused a stench and degradation in the local environment. This situation was further complicated when waste pickers and animals rummaged through the waste and scattered waste in the street (Photo 4.1).



Photo 4.1: Waste dumped outside the containers, scattered on city main streets.

(Source : By author during field survey 2004)

After the intervention of the community waste collection system, it was found that the localities were much cleaner. It increased awareness and changed the behaviour of the residents. The direct participation and resource contribution of the community residents increased community responsiveness and ownership feelings (Kazi 1999b). These community-based initiatives became popular and were replicated in major towns and cities. A variety of organisations with different organisational structures [(large to small), (individuals to collective)] participated in these activities. Some of

⁷ Receptacle in the form of masonry bins or metal containers built/placed by the municipality to facilitate households to keep waste, from where the municipal waste collection vehicles load waste for final disposal.

them were successful while others were sporadic in nature and failed to continue the service.

According to Yousuf (1998); Zamana (2000), the main constraints of the community-based waste collection services were:

- Lack of co-ordination between the municipalities and the community initiatives in the transfer interface and as a result, waste was found simply piled or heaped around the secondary storage bins.
- In the secondary storage points, waste increased several times and municipalities were not able to make sufficient arrangement of secondary storage bins and transports for regular disposal.

A recent study by JICA (2005) estimated that Dhaka City Corporation was able to collect only 44 percent of the generated solid waste. It recommended the use of community initiatives in order to bring a reduction in and better management of waste, this could offload municipal responsibility as well as waste transportation and disposal costs.

It can be summarised from this section that community organisation and its development is a natural phenomenon developing out of the need of people for better living. In the present circumstances, the role of the public sector is lessening and a large number of initiatives are growing with the goal of human, social and economic development. There has been greater momentum in the voluntary sector. Two decades ago, there were hardly any pressure groups in the society. Now NGOs, professional groups and civil society organisations are crystallizing to raise voice against the problem areas and acting voluntarily. A remarkable breakthrough has been achieved in the solid waste management sector also. The conventional attitude of the community is changing. They have realised that solid waste management is not the sole responsibility of local authorities; the community also has a role to play. A large number of local NGOs, CBOs, neighbourhood committees and associations are coming forward with a mission of self-help activities in solid waste management sector.

4.3 Activities of different organisations in community-based solid waste management

It is clear from the previous section that the motivation behind the community initiatives of community-based solid waste management was environmental concerns and municipal failures to provide satisfactory and efficient conservancy services. It is very difficult to grasp the accurate number, structure and roles of the different initiatives. Some self-financing NGOs were operating the primary collection services motivated by income generation, health and environmental improvement. Some international NGOs were incorporating primary waste collection activities into their environmental and health programmes. Some social organisers, political figures like ward commissioners were sponsoring the waste collection programme for their political gain and popularity. Most of the efforts were on an ad-hoc basis and did not run on a long term basis. Some NGOs and CBOs were successful in promoting the primary waste collection services and their activities had a lasting effect. JICA (2005) in its master plan identified five types of wards in terms of coverage of door-to-door waste collection services (Table 4.1).

Type of ward	Nature of primary waste collection services
Type A	One or two NGOs with the permission from DCC covered the whole ward.
Type B	Various local organisations/individual persons/informal resident associations were providing primary waste collection services. Some areas were out of the service.
Type C	Many local organisations were providing primary waste collection services, they co-ordinated among them and covered the whole area.
Type D	DCC cleaners were informally collecting wastes from house-to-house.
Type E	No primary waste collection services in the ward.

There were various types of organisations from individuals to collective, small to big, ad-hoc to registered working for primary waste collection services in Dhaka city. The NGOs⁸ and CBOs⁹ waste collection activities were concomitant. Therefore, it is

⁸ NGOs (Non-Governmental Organisations) are not for profit organisations, registered with the Directorate of Social Services, established and governed by a group of citizens for a stated philanthropic purpose supported by voluntary individual contribution or funded from donor agency.

difficult to draw a boundary between these two organisations, but both were working in the community as voluntary and people's organisations with a primary goal of improving the quality of life of the community people. Some organisations such as neighbourhood associations or housing societies were developed from the local demand and run by organised committees. The types, activities, legal and financial situation of the organisations involved in primary waste collection activities are described in Table 4.2 to give an overall picture of their operational procedures (Ali and Cotton 2001; JICA 2005).

Table 4.2 Different organisations and their activities in solid waste management			
Type of organisations	Activities	Legal status	Source of finance
NGOs	(a) Waste Concern as part of the composting project carried out house- to- house waste collection services in four communities.	Registered with social welfare ministry	UNDP grant and waste collection fees from household
	(b) BIEDF (Bangladesh Integrated Environmental Development Forum) a NGO in association of 40 member NGOs/CBOs got formal permission from Dhaka City Corporation (DCC) to provide house- to- house waste collection service.	Registered with social welfare ministry Some member NGOs/CBOs had trade licence	Membership fee, Income from organisational activities, waste collection fees from household
	(c) International NGO like ICDDR,B gave training to community members/leaders and operated primary waste collection service as part of their environmental health programme.	International organisation registered with social welfare ministry	Foreign donation
	(d) Some local NGOs carried out primary waste collection programme as part of income generating activity	Registered with social welfare ministry	Arranged funds from government and donor, Income from organisational activities, waste collection fees

NGOs' activities are not restricted to locality or community may operate as national or international. Their activities include social welfare, micro-credit, health, education, security as well as waste collection.

⁹ CBOs (Community Based Organisations) are voluntary in nature; non-registered organisations emerge as civil organisations working in local areas in response to local requirements/needs such as waste collection, night security etc.

			from household
	(e) JICA provided sub-contract to NGO Prism for piloting community-based solid waste management in two wards (W-7, W-65) based on community appraisal and participation	Registered with social welfare ministry	Foreign fund
CBOs	(a) Previously established for social welfare services like night security, anti-drug campaign extended activity to primary waste collection	May have or have not trade licence	Membership fee, Income from organisational activities, waste collection fees from household
	(b) Newly established for the waste collection service	May have or have not trade licence	Waste collection fees
Neighbourhood associations / Housing societies	These organisations under co-operative arrangement carried out waste collection services with other services like security, school, religious institutions	Enlisted with co-operative society	Membership contribution
Private companies	In posh residential area like Baridhara, the welfare association engaged a private company named Earth for their cleanliness and security services.	Trade licence	Monthly paid by residential committee
Government employees welfare association	In the government staff quarters, waste collection bins were provided by the government in the premises. But the associations introduced door-to-door waste collection service by themselves to remove waste from the door step to the communal bins.	Welfare association, not registered	Government arrangement, contribution
Youth/Sports	The main activities of the clubs were to organise games, cultural activities and social works. The local clubs along with their voluntary activities were motivated to do waste collection services in their areas with a perceived objective of community welfare.	Some were registered and some were not	Individual subscriptions and donations
DCC cleaners	Where there was no organisation providing waste collection service, mainly in old Dhaka, DCC cleaners were informally collecting waste from households and residents were paying some money to them.		Informal arrangement payment by residents

Individual person	Some poor people engaged in house-to-house waste collection service usually for their survival.		Waste collection fees
Ward commissioner's initiative	Ward commissioners/Female commissioners in some wards took initiative by themselves for his/her political gain from the cleanliness or for engaging the political followers to earn from the waste collection service.		Sponsored by ward commissioners, sometimes waste collection fees as an income source for political affiliate

The service charges for the primary waste collection varied from Tk¹⁰.10 to Tk. 50 per month in low and middle income areas and Tk. 50 to Tk.100 or more in high income areas (Sheltech 2004). Unfortunately, the slums and squatter settlements were outside of any formal or informal waste collection service in Dhaka city. The only waste management service in two slums was provided by Waste Concern as part of their barrel composting project (Sinha and Enyetullah 2000).

In Khulna City, another city with a history of community participation, a local NGO, Prodiapan, first started its community-based waste collection service in 1997, getting financial support and technical assistance from the Swiss Agency for Development and Co-operation (SDC) and the Water and Sanitation Programme (WSP) of the World Bank, respectively. The programme piloted its waste collection services in six wards, serving 22 communities. It was a replication of the house-to-house waste collection initiative of Kalabagan, Dhaka (see Box 4.2). One of the project strategies was to integrate the community-based activity with the formal waste management system of Khulna City Corporation. (Ahmed 2004; Appleton et al. 2000). Some other NGOs/CBOs, such as Muktir Alo, Shabolombi, Amader Paribartan, Rustic and Nabarun Shangsad, were engaged in primary waste collection in ten wards (Murtaza and Rahman 2000). Prism, a national NGO had extended its waste collection services in 26 wards out of 31 wards in Khulna city under a UNDP funded programme. In total, 14 NGOs/CBOs were collaborating with Prism in that programme (Chowdhury 2004).

¹⁰ 1 ₳= Taka (Tk.)115 on 20.03.05

In Sylhet city, some sporadic primary waste collection services were started by the CBOs AYA (Association for Youth Advancement), Brikko Chaya, SSKS (Sylhet Samaj Kallyan Sangshta) in the year 1998 and 1999 in different residential areas before the European Union Asia-Urbs programme was launched. The Asia-Urbs programme started primary collection service in two wards on a pilot basis through Sylhet Partnership Company in 2001. It made the CBOs frustrated and they discontinued the waste collection services (Saha 2003).

From the above, it can be concluded that community-based waste collection services gained importance and became part of the community activities. Due to the absence of guidelines or rules, some organisations were growing with no transparent management and financial system. Sometimes people did not know who was organising the activities and to whom they were paying collection charges. Sometimes there were political influences over the control of the collection activities which destabilised the service and undermined the service quality. In Khulna, all the NGOs and CBOs primary waste collection services were brought under an organised network to avoid duplication or conflict. In Sylhet, most of the activities were started by NGOs/CBOs on an ad-hoc basis and did not last for a long periods.

The local initiatives served mostly middle to high income settlements where households were willing and could afford to pay user charges. The low income households were generally excluded from both the formal and informal waste collection services as it was felt that they would not be able to pay for waste collection service. However, ignoring them would cause detrimental effects to the overall health and environment of the neighbourhood (Richardson 2003).

4.4 Participation of Local government in community waste management

There are no guidelines or rules for primary waste collection and other waste related activities in solid waste management at either a local level or at the ward level. The structure and role of the various organisations engaged in primary waste collection are not clearly defined in any of the official documents. CBOs were growing spontaneously in an unplanned and unregulated way. Different organisations (formal and informal) were conducting activities for their own concerns or interests. There was no common platform for the organisations to discuss and co-ordinate the

activities at the ward level and/or at the neighbourhood level. In some wards, there were conflicts among organisations which created obstacles to start or expand the waste collection services. In some wards, ward commissioners themselves obstructed the activities of the NGOs or local CBOs. Ward commissioners are key actors in the local/ward level activities. Without their co-operation and support, it was difficult for the organisations to carry out their activities in the wards.

According to municipal ordinances, the municipalities are the sole responsible authority for solid waste management. However, due to the inefficient and unreliable services of the municipalities, the communities came forward with a mission of cleanliness for their localities. At the beginning, there was an unsound relationship created between the community organisations and the municipalities. This situation was improved when municipalities realised the benefits of the local level waste management services. They became pro-active and assisted the community initiatives by donating old rickshaws (manually driven tri-cycles) for use as waste collection vans and, this made them unofficial partners in solid waste management.

There is still a lack of co-ordination in the secondary storage and transportation interface. Due to lack of accountability of the community initiatives, it is commonly found that van drivers unload their wastes around the communal bins/containers which occupy a major part of the city streets. The municipality has to employ extra labour to reload the waste into the containers. To bring the waste collection initiatives into line, Dhaka City Corporation took some milestone steps. These include:

- Since 2002, Dhaka City Corporation (DCC) has introduced a system of permissions for NGOs/CBOs who have the capacity to provide waste collection services basically in a ward or a part. So far DCC has given permission to 47 NGOs to work in 57 areas covering 52 wards, out of its 90 wards (Faruqui 2004). Among them BIEDF (Bangladesh Integrated Environment Development Forum), an NGO with 40 member organisations, was operating waste collection services in 38 wards. Some conditions were imposed upon the CBOs/NGOs (Box 4.3) to make their activities streamlined. A marked improvement was observed both in locality and in the secondary storage points after the co-ordinating effort was taken by Dhaka City Corporation. From the experience of BIEDF, some unusual incidents also occurred. A commissioner, who attended the opening ceremony as chief guest, later started motivating the community people to not pay the service charge

and told the organisation to stop the collection service in his ward. As a result of non-cooperation of the ward commissioners, community organisations were not be able to start waste collection services in 18 wards (Huda 2004).

The above indicates that co-operation of the ward commissioners is vital in community level waste services; otherwise they become opponents of the programme. The community initiatives have to rely on municipal support. Without some degree of municipal support and co-ordination (logistic or legal), community initiatives are not able to sustain their activities.

Box 4.3: Conditions imposed upon CBOs/NGOs to operate house-to-house waste collection services

- *To provide door to door waste collection service.*
- *To design rickshaw vans to make provision of segregation organic and inorganic waste.*
- *To carry out awareness programmes to motivate people including school children for proper solid waste management.*
- *To submit reports to Dhaka City Corporation (DCC) every three months to make DCC aware of their activities and services.*
- *To support or to integrate the activities of DCC waste collection at the secondary point.*
- *To arrange/manage the secondary points in such a manner that the number of dustbins or containers could be reduced and thus traffic movement eased and the environment improved.*

Source: Dhaka City Corporation, 2004 (Translated copy from Bengali language)

- Another progressive step taken by Dhaka City Corporation was the privatisation of waste management services in two zones (zone 9 and 10), covering eight wards through a competitive bidding process. Four private companies were awarded the contracts, namely BIEDF (Ward No. 18, 19, 20, 21, 38), MIRUD (Ward No.1), Rhythm (Ward No.17) and L N Corporation (Ward No. 37). The responsibilities of the organisations were the sweeping of roads and public places, and transporting waste from dustbins to landfill sites. Their performances were evaluated through ranking (A to D) by the conservancy officers of DCC. The private companies recruited outside labours as cleaners. At the beginning, resistance came from the DCC cleaners but the matter was resolved on deploying the DCC cleaners in other areas. Some of the important lessons for DCC from the privatisation process were:

➤ The private companies engaged fewer cleaners (43 percent) than DCC employed in those areas [DCC employed 646 cleaners instead private companies engaged 365].

➤ They also deployed a reduced number of trucks (60 percent) [DCC engaged 49 trucks; whereas private companies 20].

➤ They rearranged and reduced dustbins from 111 to 73 in consultation with DCC and local communities.

➤ The total allocation of fund for this privatization programme was Tk. 4.75 crore¹¹, which was 25 percent less than DCC's operational cost of Tk.6.40 crore per year (Faruqui 2004; Huda 2004).

The privatisation contract was completely officialdom. There was no complaint system or involvement of the community in monitoring the activities of the private companies. The duration of the contract was for one year, too short for the private companies to invest adequate and necessary capital for better performance. DCC was thinking of extending the contract based on their performance. There was no supervisory role of the ward commissioners which caused them dissatisfaction and might have hampered the privatisation effort to some extent (Box 4.4).

Box 4.4 Reaction of a ward commissioner against the privatisation programme

The Ward commissioner of ward no. 19 (Gulshan-Banani) had raised his dissatisfaction about the cleanliness service of the private company in a seminar on community-based solid waste management of Dhaka city organised by JICA on 08-03-04. He complained about the lack of experience, equipment and manpower of the company, which gave his ward a dirtier look than before. He received a number of complaints from the public about stinking piles of garbage in the streets. He was elected representative of the community people and accountable to them for all concerns of his ward including garbage cleansing.

The overall performance of the privatisation effort was good for improving the service quality as well as cost savings of DCC. It also indicates that DCC was coming out from the traditional management of solid waste and looking for solutions for their waste problem. However, DCC was not transparent in evaluating the performance of the private contractors and made no provision for community supervision or ward commissioners' roles in the privatisation contract.

- Another marked initiative of Dhaka City Corporation was the construction of wheel mounted containers with ramp facilities on a pilot basis for establishing

¹¹ 1 crore = 100 million, 1 £ = 115 Taka (Tk.) on 20.03.05

synchronization between community-based waste collection service and DCC secondary transportation (Photo 4.2).



Photo 4.2: Wheel mounted secondary storage container
(By author during field survey 2004)

In Khulna, Khulna City Corporation (KCC) was first to sign a formal Memorandum of Understanding (MoU) with Prodiplan, a local NGO, in 1997 to endorse the private sector as a partner of KCC for solid waste management. It opened up an opportunity for communities, the private sector and KCC to work together. This MoU was a legal basis or support to convince community residents to subscribe for door-to-door waste collection services (Ahmed 2004). The MoU signed between Prodiplan and KCC was also a symbol of recognition of community-based activities. The KCC officials treated the MoU as an official document as it was approved by the highest authority of the corporation. This facilitated the other NGOs/CBOs to work with KCC in the following years.

From this section, it can be concluded that the local government authorities were taking a facilitative role and extending their co-operation towards the community-based waste management initiatives. The political motivation at the city levels was gradually increasing in favour of community-based initiatives. Involvement of ward commissioners at the ward level activities could increase the chance of the programmes being more participatory and successful.

4.5 Community-based composting efforts in Bangladesh

During field work in Bangladesh, community-based composting projects were found operational in three cities- Dhaka, Khulna and Sylhet. In Dhaka city, Waste Concern was operating three composting projects at Mirpur, Green Road and Dhalpur area on a

Public-Private-Community partnership approach, and two barrel composting projects in slum areas. Prism, a national NGO, was operating two composting projects in Khulna city through CBO-NGO collaboration. Sylhet Partnership, a company formed through European Commission Asia-Urbs programme was operating one composting plant on a commercial basis. All the composting plants were associated with primary solid waste collection service.

4.5.1 Public-Private-Community Partnership (PPCP) composting project of Waste Concern

Waste Concern¹², a local NGO, is considered a pioneer in community-based composting in Bangladesh. It has developed a Public-Private-Community partnership composting model in three residential areas (Mirpur, Green Road, and Dhalpur) in Dhaka City. The Public-Private-Community model designed by the NGO was a tripartite partnership among public agencies [Dhaka City Corporation (DCC)¹³ and the Public Works Department (PWD)¹⁴], the Community and a Private Fertiliser Company. Waste Concern was providing technical and management support to the project. UNDP was funding the project under the 'Sustainable Environmental Management Programme' (SEMP¹⁵). A formal agreement was signed between the public organisations (DCC, PWD) and the NGO Waste Concern for providing pieces of lands free of charge and for making arrangements for water and electricity

¹² Waste Concern is a non-governmental research based organisation established in the year 1995. Working closely with government, private sector and local communities to improve the solid waste conditions in the cities and towns of Bangladesh, the organisation has promoted the concept of waste as a resource, stimulated behavioural changes in urban communities, encouraged the government bureaucracies in the participatory process and developed marketing aspect of organic compost.

¹³ Dhaka City Corporation (DCC) is entrusted with the responsibility of solid waste management in Dhaka City under the 'Municipal Ordinance 1983'. Street sweeping, drain cleaning, waste collection, transportation and disposal are the mandatory functions of this organisation. The present service of waste management is primitive in nature and follows the open loop (collection-transportation-disposal) of waste management.

¹⁴ Public Works Department (PWD) under the Ministry of Housing and Public Works are mainly responsible for the construction and maintenance of government offices and accommodation buildings. Along with accommodation facilities, this organisation provides utility and waste management service to the occupiers of the buildings. For the collection of wastes from the premises, Public Works Department usually pay a fixed amount of money annually to Dhaka City Corporation.

¹⁵ SEMP (Sustainable Environmental Management Programme) is UNDP funded (US\$ 26 million) environmental management programme under Ministry of Environment and Forest involving 22 sub-implementing agencies. It supports community capacities for sustainable management of environmental resources, strengthen capacity of the public sector to develop new framework for policy development, and promoting sustainable development through advocacy and awareness.

connections. Primary waste collection was the integral part of the project, where community residents were participating in primary waste collection service by contributing waste collection fees. A private fertiliser company (MAP and Alpha Agro Ltd.) was buying the compost, enriching it with nutrients and selling it through its marketing channels.

The aims of the project were to:

- (i) create public awareness of waste management
- (ii) capture value from the organic portion of solid waste
- (iii) reduce the quantity of solid waste at source, resulting in saving municipal collection and disposal costs
- (iv) create job opportunities for the urban poor
- (v) promote business opportunities for local entrepreneurs
- (vi) explore private sector participation in compost marketing

4.5.1.1 Background of the project

With a mission to promote the concept 'waste as a resource', Waste Concern first approached Dhaka City Corporation to provide a piece of land for piloting the waste reduction technology by composting. However, the city authority was not convinced of the idea of waste reduction and thought that it would lead to a putrid dump inside the city (Sinha and Enayetullah 2000). Waste Concern took this as a challenge and motivated Lions Club (a local charity) who agreed to provide land in a residential area at Mirpur. It was a challenge for Waste Concern as no one wanted waste activity inside the community. With the help of the German Cultural Centre Goethe Institute, Dhaka Waste Concern conducted a survey of the residents of Section-2, Mirpur Housing Estate to determine their opinion on better solid waste management, and their willingness to participate and contribute to a local environmental improvement programme. Getting a very positive response from the community for the alternative solid waste management approach and their willingness to participate in the programme, Waste Concern encouraged initiating the first community-based decentralised composting project. Capitalising on the organic waste stream and utilising the waste collectors, in 1995 Waste Concern commenced their innovation on

a small-scale. Two composting techniques Chinese Covered Pile¹⁶ and Indonesian Windrow¹⁷ were experimented with in the field. From the field demonstration, Waste Concern decided Chinese Covered Pile would not be appropriate because of the odour problem; but the Indonesian Windrow pile (Photo 4.3) was better odour controlled and would be suitable inside the community setting. Observing the success of the community-based programme that addressed the community's needs in a participatory manner, in 1997 the Regional Urban Development Office (RUDO) - South Asia, USAID extended their support to increase the capacity of the project. Waste Concern's pilot project gradually gained the attention of the government authorities, research institutions, donor agencies and private entrepreneurs. The initiative got extensive local and international media coverage. Running the demonstration project for five years, Waste Concern was able to convince Dhaka City Corporation (DCC) and the Public Works Department (PWD) to provide their unused lands for community composting. After getting the land from government organisations and the financial support from UNDP's Sustainable Environmental Management Programme (SEMP), Waste Concern replicated the Mirpur model in three other communities in Dhaka City on a Public-Private-Community Partnership approach. At the beginning of the project, marketing of compost was a problem. This was overcome by utilising the existing network of the private fertiliser and pesticide distribution company Alpha-Map Agro Limited. The company was renowned for its fertiliser and pesticide distribution. Waste Concern signed a Memorandum of Understanding (MoU) with the company who purchased the compost in bulk, enriched it with chemical fertilisers and sold it in the fertiliser market.

¹⁶ In Chinese Covered Pile process, waste is heaped on the ground or in a trench and a cover of clay mixed with straw is placed on top of the pile to prevent heat and moisture losses. Waste decomposes anaerobically in the pile for weeks (Lardinois and Klundert 1993).

¹⁷ Indonesian windrow is an aerobic composting process in which waste is piled around a triangular aerator rack made of wood or bamboo which allows improved air circulation. The pile arrangement itself generates thermophilic temperature to kill the pathogens (Diaz et al. 1993).



Photo 4.3: Windrow composting in Waste Concern Composting plant
(Source: By the author during field survey, 2004)

4.5.1.2 Activities of the project

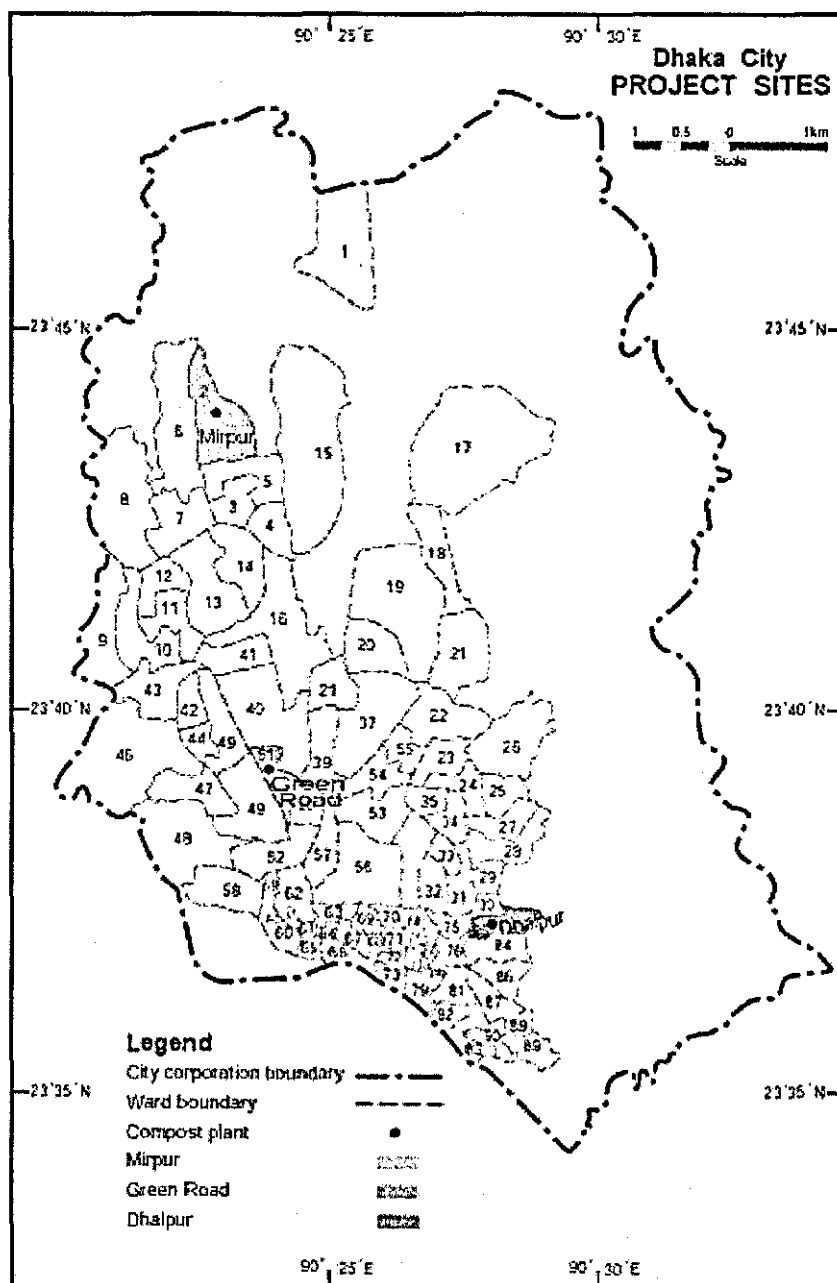
Waste Concern was operating three composting projects in Dhaka City at Mirpur, Green Road and Dhalpur (Map 4.1). The composting plants were small-scale and labour-intensive with a capacity to manage 1 to 5 tons of waste in the community and created job opportunities for the urban poor.

The community-based composting project of Waste Concern incorporated the following steps (Fig 4.1):

- Signing an agreement with the public agencies for land for the composting plants.
- Conducting socio-economic surveys to ascertain the willingness of the residents to participate in and contribute to a waste management improvement programme in the locality.
- Mobilising the community residents by arranging formal and informal meetings with the community leaders and community residents, and distributing posters and leaflets to make them aware of the benefits of cleanliness.

- Forming a community group (Green Force¹⁸) comprising of housewives, youths and retired persons to monitor the activities.

¹⁸ Green Force – a group of people from the community who volunteered to act as watchdogs specially the housewives, youths and retired persons who can spend time and effort for the project.



MAP 4.1: Public-Private-Community-based composting projects of Waste Concern in Dhaka City.

(Source: Dhaka City Corporation, 2002)

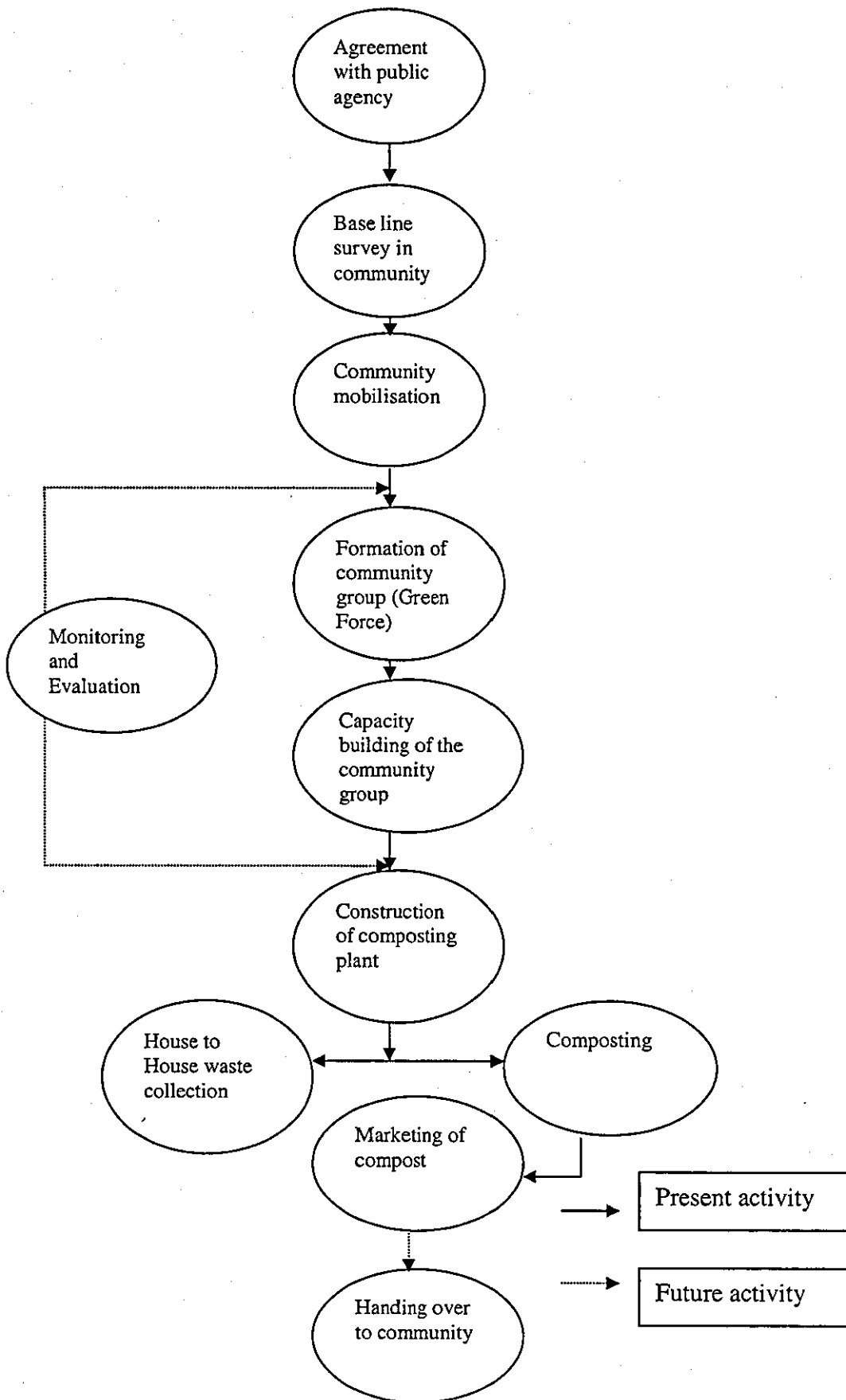


Fig 4.1 Different steps of community-based composting adopted by Waste Concern

Key features of the project:

- Community participation was limited to giving waste to waste collectors and to paying charges in exchange.
- Waste Concern was providing technical and management support of the project.
- Government bureaucracy was encouraged to provide land for composting.
- A marketing network was developed with the private fertiliser company.

4.5.2 Barrel type composting in slums and squatter settlements

This was the first intervention in the slums and squatter settlements involving the urban poor in managing their own solid waste. A large section of poor people [1.5 million (CUS 1990)] are living in the slums¹⁹ and squatter settlements²⁰ in Bangladesh. These people were migrated into Dhaka city due to rural pushes (landlessness, unemployment, natural disasters etc.) and urban pull (employment opportunities). CUS (1990) identified 3007 clusters of slums and squatter settlements in and around Dhaka city. These informal settlements are illegal and the government sometimes bulldozes them. The slum dwellers are low income people living in congested substandard housing devoid of proper sanitation and water supply facilities. According to an interim report of the World Bank (2001), in Dhaka city there were nearly 90 percent of the slum people live in single and very poor quality shelters and 55 percent of them had no access to sanitary latrines. They do not pay municipal taxes; therefore, they are not entitled to get solid waste management services from the local authority. They are also excluded from the door-to-door waste collection services of the organised community as it is assumed that they would not be able to pay. About 46 NGOs were working in different slums in Dhaka city for health and credit programmes, which mainly covered water supply, sanitation, health education, and mother and children care (ADB 1996). The slum improvement programme (1999-

¹⁹ Slums are substandard housing built on privately owned land where the dwellers pay monthly rent to the land owner.

²⁰ Squatter settlements are substandard housing built illegally on public land. Some of the dwellers who live for years claimed as owner and sometimes rent rooms to new comers.

2001) under UNICEF funded project, tried to construct masonry bins for solid waste disposal but failed due to difficulty in getting space in the congested slums.

The slum dwellers are free-riders; they have no legal right to get the municipal services. They are generally treated as polluters of the city environment (Richardson 2003). The barrel composting approach in the slums by Waste Concern indicated that low income communities are not the cause of environmental degradation of cities but they can maintain a clean and liveable environment if they get external support. The barrel composting project radically changed the attitude and habits of slum dwellers towards waste disposal and created income opportunities for them. The aims of the barrel composting were to:

- (i) involve the slum-dwellers and enable them to improve their living environment through managing their own waste.
- (ii) create income opportunities for the slum dwellers through resource recovery of waste.

4.5.2.1 Background of the project

On obtaining financial support from UNDP's Local Initiative Facility for Environment (LIFE), Waste Concern started its first pilot barrel composting project for the slum dwellers in Dhaka city in the year 1998. This barrel concept was adopted from the SriLankan NGO SEVANATHA which introduced compost bins for household waste disposal. This was a low cost, simple and environmental friendly method of waste disposal, which would not require a large space for its installation. In this method of composting, a specially designed 200 litre plastic/metal drum perforated on the bottom and sides with a conical cover (to prevent people sitting on it) was placed on two half-round cement slabs, which allowed air movement up through the bottom of the drum. One barrel was supplied for keeping the organic waste and normally shared by 5 to 7 families. The other barrel was for inorganic waste and shared by 10 to 15 families. To distinguish the barrels, a green/blue colour was used for organic and yellow for inorganic waste (Photo 4.4).



Photo 4.4: Barrel composting in slums

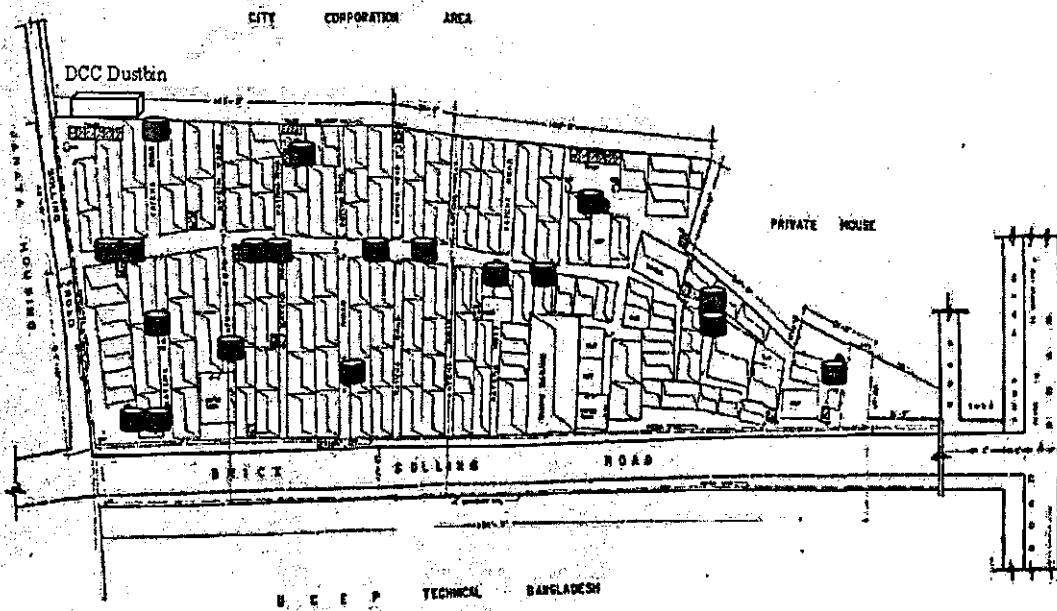
(Source: By the author during field survey,2004)

Getting appreciation and financial support from donors, attempts were made to replicate this model of waste disposal in other slums of Dhaka in subsequent years. Waste Concern started its first pilot project in Shah Ali Bagh slum, and then extended it to other slums (Kolwalapara, Gulshan, Kallyanpur, and Nasimbagh) with support from LIFE-UNDP, OXFAM-GB and SEMP-UNDP. During the survey, barrel composting was found only in two slums at Shah Ali Bagh and Nasimbagh. The others were damaged by government eviction or stopped functioning due to non-cooperation of the slum dwellers. The two projects in Shah Ali Bagh and Nasimbagh slums were currently supported by UNDP's Sustainable Environmental Management Programme (SEMP). An overview of the results of field observation and questionnaire survey in 2004 to ascertain the socio-economic situation of the slums, are presented in Box 4.5 and 4.6 respectively.

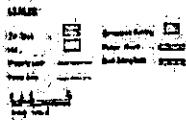
Box 4.5 Overview of the Shah-Ali Bagh slum

The slum was on government land, where most of the residents had been living for more than 20 years. A total of 149 families were living in that slum, 120 households (more than 80 percent) were participating in the compost projects. Among them 55% were owners and 45% tenants. The residents who had lived for more than 10 years claimed themselves as owners of the houses. The makeshift houses were made of bamboo and some of the houses were vertically extended for renting others. The room sizes were approximately 80 sq.ft to 120 sq.ft. The average rent of the houses was Tk.500. The average size of the family was 5. Most of the males worked as rickshaw pullers (human pedalled tri-cycle), daily labourers, hawkers and the women worked in garment factories or as domestic helpers. Their monthly income was on average Tk. 1500 to Tk. 2000. In the slum, there were 10 common toilets provided by an NGO DSK (Dhusta Shasta Kendra), 2 water points provided by Water Aid. The internal passages and drainage were constructed from the UNICEF's slum improvement programme. The slum dwellers were paying TK. 200 for electricity and Tk. 20 for water on a monthly basis to the bill collector of the NGO. One sweeper of Dhaka City Corporation, who was living in that slum, used to clean the drainage and for this service he was exempted from payment for water and electricity. The slum dwellers had applied for gas connection but this was refused due to their illegal occupancy status. They were organised, there was little fear of eviction by the government. The slum was ideal for barrel composting. 20 organic barrels (each shared by 5 to 7 families) were placed in consultation with the leaders of the slum (Map 4.2). The bins were placed very close to the houses around 5 to 10 ft, placed over the drain and even in front of the houses. The households had been operating the barrel composting for more than 5 years. The inorganic barrels were removed when DCC constructed a dustbin near the slum.

(Source: Field survey 2004)



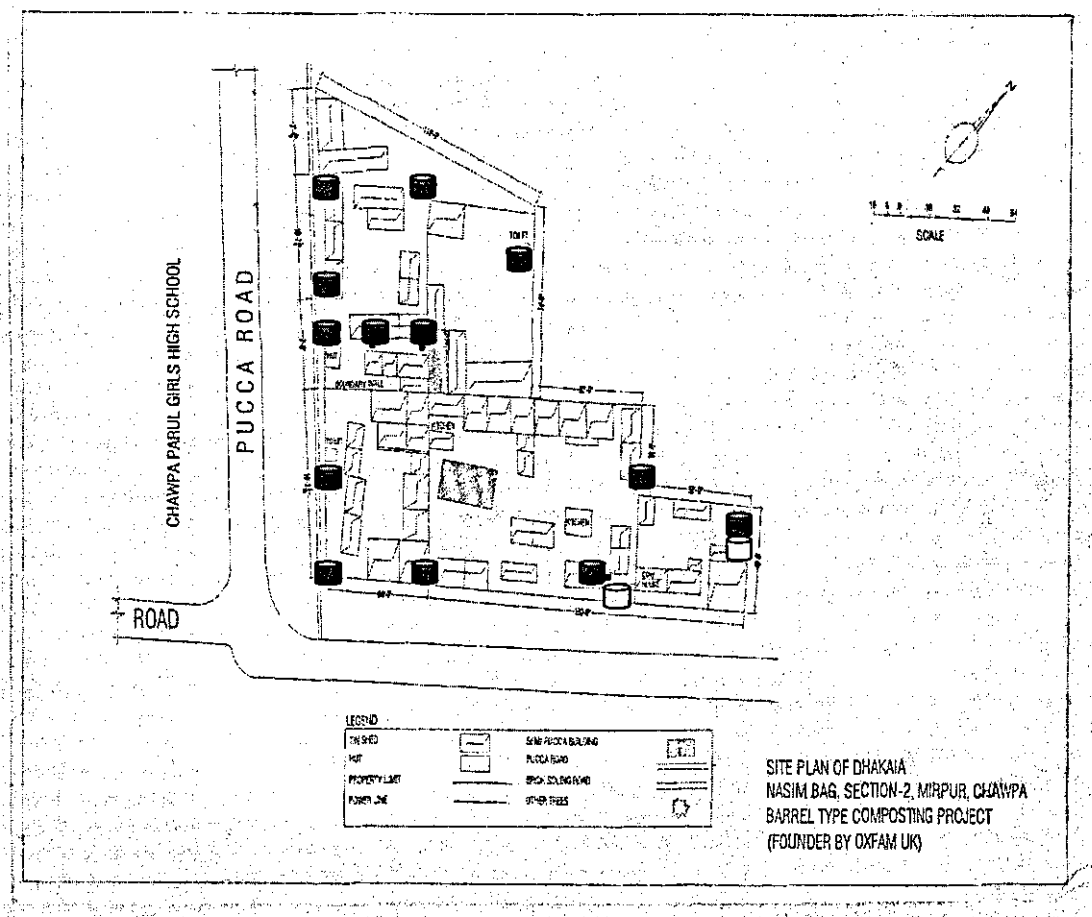
Site Plan Showing the locations of the 'Barrel Type Composting Units' Inside the Shah Ali Bag Basti Located at Section 2, Mirpur, Dhaka



Map 4.2: Site plan of Shah Ali Bagh barrel type composting units (Adapted from Waste Concern)

Box 4.6 Overview of the Nasimbagh Slum

In Nasimbagh out of 150 households, 60 households participated in the barrel composting project. The slum was in a privately owned property. All the houses were rented by the owner of that property. Rent of the houses (80 to 100 sq.ft.) was Tk. 600 to Tk. 700 including water and electricity bill. There was no intervention from other NGOs in that slum. Slum dwellers had been living for an average of 5 to 10 years in the property. The drainage system was poor; water logging was very common, which disrupted the operation of barrel composting in the rainy seasons. 80 percent of the slum dwellers were rickshaw pullers and 15 percent were daily labourers. 60 percent of females worked as domestic helpers. 14 organic and 2 inorganic barrels were installed at 10 to 20 ft. distance (Map 4.3). There was no committee or association in the slum. Waste Concern had permission from the landlord to carry out the activity. The locations of the barrels were selected by Waste Concern in consultation with the landlord. 6 households shared one organic and 24 families shared one inorganic barrel. The project had been running for more than 4 years. Previously, the programme was supported by OXFAM-GB; the new barrels were replaced by the SEMP-UNDP programme. (Source: Field survey 2004)



Map 4.3: Site plan of Nasimbagh barrel type composting units (Adapted from Waste Concern)

4.5.2.2 Activities of the project

The barrel composting process followed several steps (Fig 4.2) such as mobilisation, awareness, practical demonstration, group formation, barrel installation, monitoring and evaluation, and finally compost collection and sale. This was supplemented by socio-economic, health and physical surveys.

- As part of the mobilisation and awareness programme, social mobilisers visited every household in the slums and explained about waste segregation and the benefits of waste recycling and recovery. Very simple visual aids such as posters, video-films and photographs were used to acquaint the community members with the project.
- Formal and informal discussions and meetings were held with the slum leaders and dwellers as part of the awareness programme.

- Routine health check-ups and medicines were provided to the slum people as an incentive for participation and for building awareness of the adverse impact (disease and illness) of indiscriminate disposal of waste.
- Socio-economic surveys were conducted among the slum people to ascertain their opinion and willingness to participate as well as their perception on improved solid waste management.
- A hand on training was given to the housewives to teach them how to segregate and dispose of organic waste into the specially designed barrels.
- Groups were formed into 5 to 7 households with a group leader for sharing the bins.
- Before installation of the barrels, a ground map containing the houses, passages and other utility services were prepared to facilitate the slum dwellers and the NGO to select suitable locations for barrels.
- Monitoring was a crucial part of the project. Community mobilisers often supervised source-separation and operation of the barrels.

Key features of the project:

- Practical demonstrations were given to the slum dwellers to make them understand the value of waste, which inspired them to carry out source-separation and barrel composting.
- Participatory techniques were adopted in the selection of barrel locations which developed ownership feelings among them.

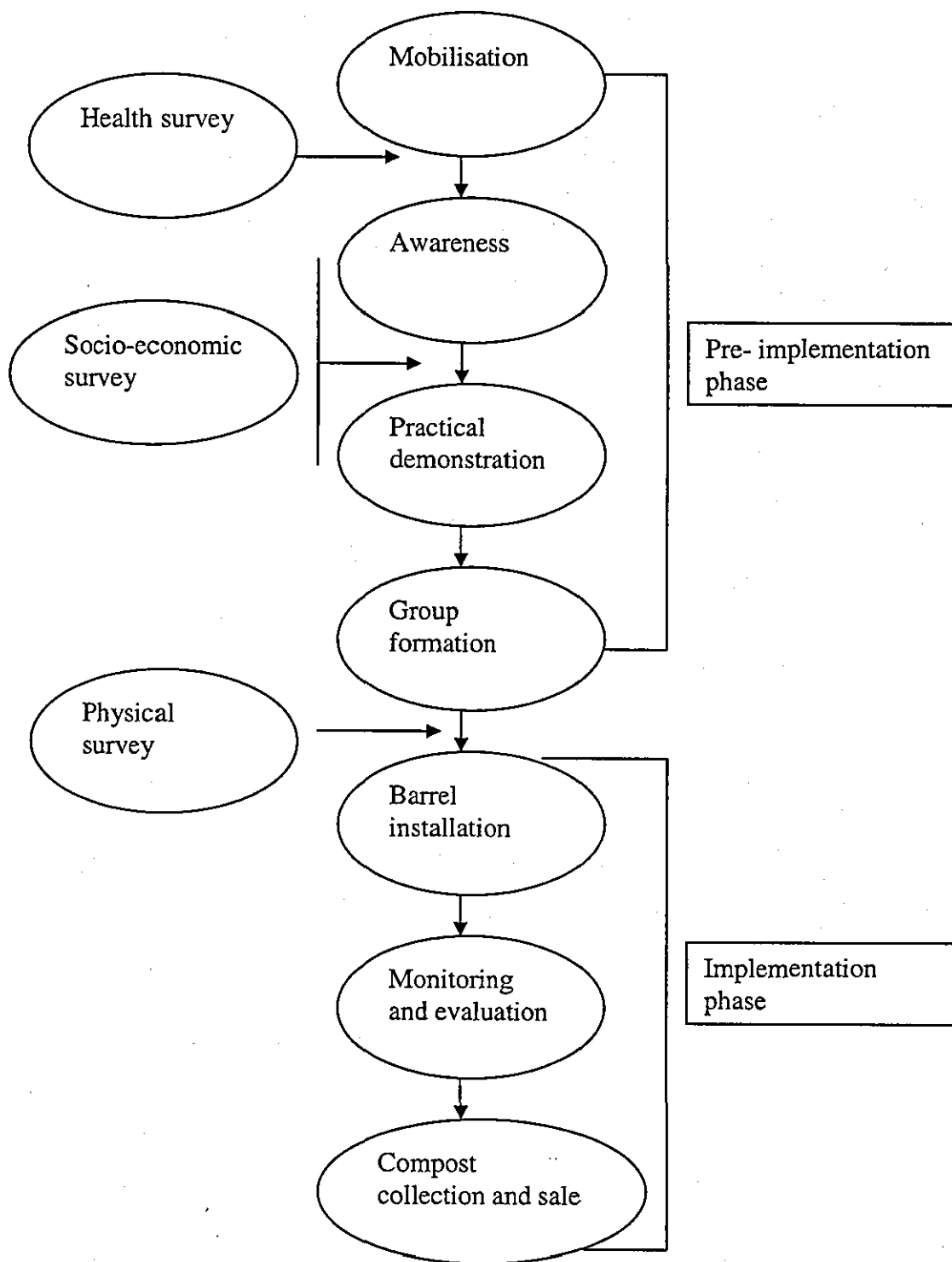


Fig 4.2: Different steps of barrel composting process in slums

4.5.3 Community-based composting project of Prism on NGO-CBO collaboration

Prism, Bangladesh, a national NGO has long experience of duck weed waste water treatment. The community-based composting was a part of the component of the SEMP-UNDP funded community-based waste water treatment project. In that project, Prism provided solid waste collection services in 26 out of total 31 wards²¹. It organised primary waste collection services involving 14 CBOs and provided them with 70 waste collection vans from the project funds. It formed 'Waste Management Committees' (WMC)²² and 'Ward Environment Development Committees' (WEDC)²³ to supervise the CBOs activities. Prism also supplied household containers for depositing waste for collection. Under this project, Prism constructed two composting plants and one maturation and packaging plant on leased lands. It successfully operated source-separation schemes in three residential areas and the separated waste was utilised in the composting plants. Two different coloured containers were provided to the households for keeping separated waste. The red coloured container was for inorganic waste which was collected once a week and the green one was for organic which was collected daily.

The aims of the project were to:

- (i) cover the whole city under a uniform solid waste collection and management system to avoid overlapping or duplication.

²¹ A Ward is a local level administrative body of the municipality which is headed by an elected ward commissioner.

²² A Waste Management Committee (WMC) was formed in each block (collection area was divided into blocks, consisting of an average of 500 households and served by one waste collection van) to co-ordinate the activities and to resolve local problems or conflicts. The majority of the committee members were school teachers, lawyers and social workers who had acceptability in the community. Each WMC consisted of a convenor with 10 to 15 members. One third of them were women. The committee members were involved in planning and implementation of the primary waste collection system in their locality. The committees met monthly with the van drivers and their assistants. Social organisers from NGO/CBO worked as member secretary who took notes of discussion.

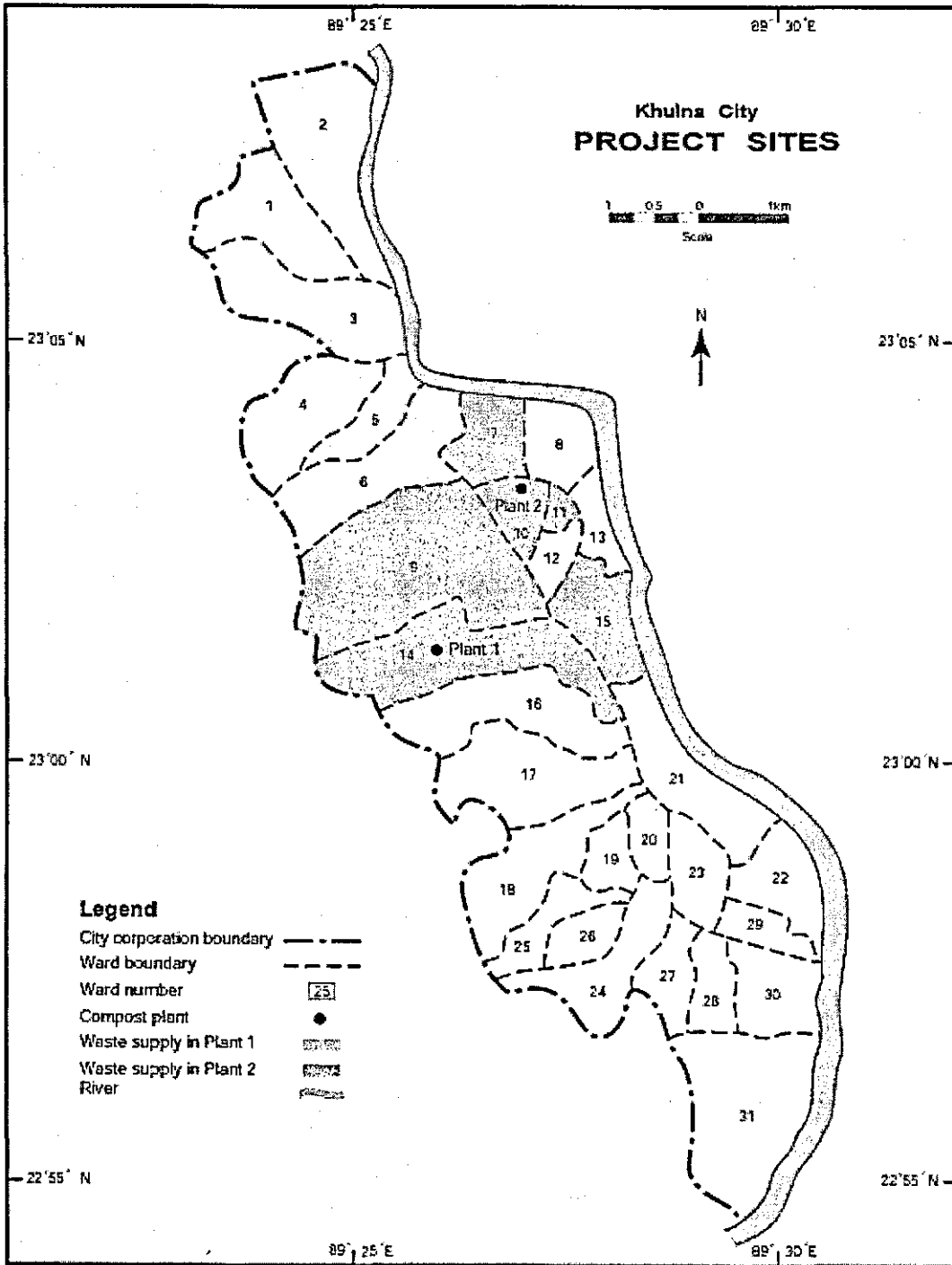
²³ Ward Environment Development committees (WEDC) were formed in all working wards as a project advisory committee to motivate the people and to monitor the activities of the partner organisations involved in waste collection. They were formed from a cross-section of social leaders/ champions of the society/ representatives of various service agencies both private and public. Ward commissioners were selected as chair persons of the WEDCs. The main intention behind the formation of WEDCs was to hand over the responsibilities of the service to them in the future.

- (ii) co-ordinate effectively between CBOS/NGOs and Khulna City Corporation (KCC) and develop synchronisation with KCC waste transportation system.

4.5.3.1 Background of the project

The project was a follow up activity of the local NGO Prodipan. In 1997, Prodipan took the initiative to manage solid waste through a community approach in Khulna city. It carried out primary waste collection services in six wards with financial support and technical assistance from the Swiss Agency for Development and Co-operation (SDC), and the Water and Sanitation Programme (WSP) respectively. The primary waste collection services of the project were handed over to the respective ward committees before the project ended in 2001. After Prodipan, no action was taken to scale-up the initiatives in other wards. Some Community Based Organisations (CBOs) tried in an unorganised manner but could not provide a quality service, and failed to achieve public confidence and credibility. After Prodipan, Prism took the initiative to organise all CBOs working in primary waste collection services. It extended primary waste collection service to 26 wards, and involved 14 CBOs as partner/associate organisations. In the Prodipan project, a composting plant was built in a dumpsite 8 km away from the city as a demonstration project. However, it could not bring any impact on reducing the waste management costs of KCC and it found difficulty in selling the compost. After termination of the project, the operation of the composting plant ceased.

In the SEMP-UNDP project, Prism took the initiative to regenerate the waste reduction initiative and it established two composting plants. In compost plant-1, the CBO Shomas Progati Sansta (SPS) supplied waste from 3 wards (ward 9, 14, 15) and in compost plant-2, three CBOs Sabolambi (ward-10), BRIC (ward-7) and Commitment (ward-11) supplied waste (Map 4.4).



Map 4.4: Location of community-based waste management activity of Prism in Khulna.

(Source: Khulna City Corporation, 2003)

4.5.3.2 Activities of the project

The major activities of the composting project were participatory appraisal, awareness and motivational programmes, formation of waste management committees etc. and these are outlined in fig 4.3 and fig 4.4.

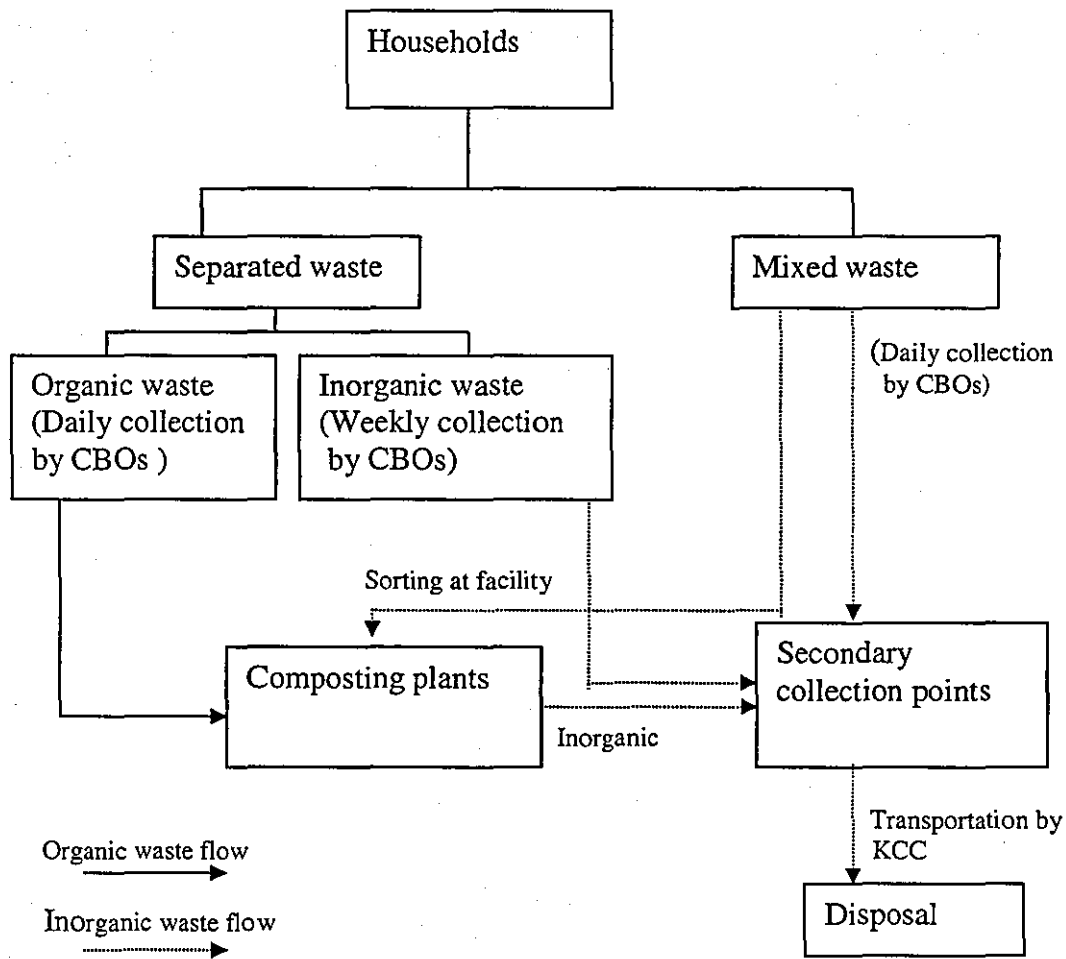


Fig 4.3: Community-based solid waste management of Prism

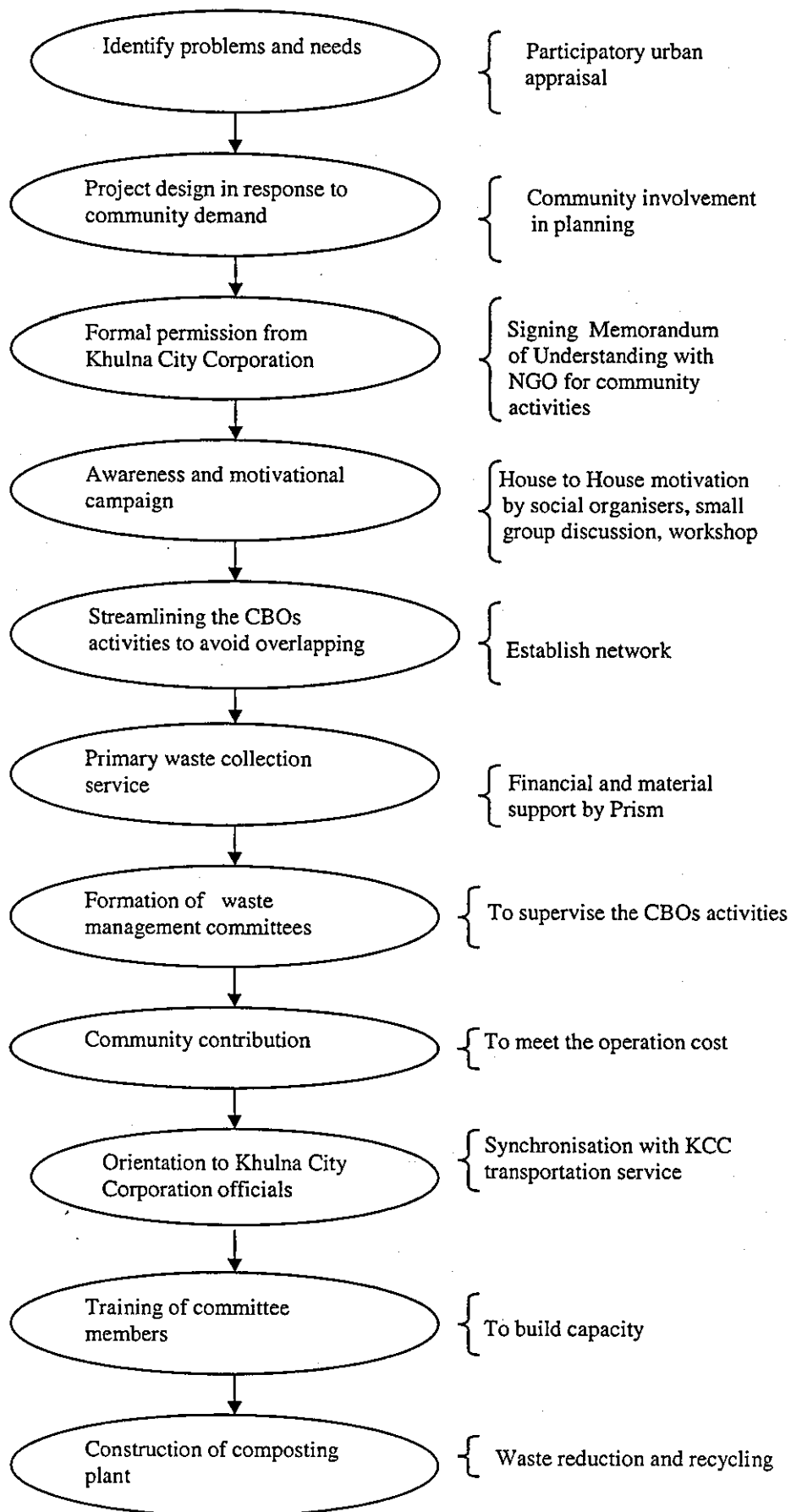


Fig 4.4: Activities of community based waste management of Prism

Key features of the project:

- CBOs were involved in house-to-house waste collection service.
- CBOs activities were supported by Prism from the project fund.
- Prism established a network among the CBOs to avoid duplication and to extend the service in the whole city in a uniform manner.
- Waste management committees were formed from the community members to monitor the CBOs activities.
- Linkage was established with KCC for regular transportation of waste.
- Source-separation was practised in some residential areas.
- Two compost plants were built for source reduction of waste.

4.5.4 Sylhet Partnership Company run composting project

Sylhet Partnership Company established a 2.5 ton capacity composting plant with the intention to offset the operational cost of the project through the sale of compost. It was integrated with a primary waste collection service in two wards and five markets.

4.5.4.1 Background of the project

The Sylhet Partnership was established as a joint effort of the London Borough of Tower Hamlets (UK) and Sylhet City Corporation. Sylhet, the new divisional city of Bangladesh, has a close link with the London Borough of Tower Hamlets as most of the councillors representing the borough are British citizens of Sylhet origin. In 1996, the London Borough of Tower Hamlets signed an Economic and Twinning Accord with Sylhet City Corporation aimed at sustainable economic, social, cultural and environmental development of Sylhet city. Partnering with the Danish municipality of Horsens, in 2000 they succeeded in obtaining a European Commission Asia-Urbs contract for an urban regeneration project in Sylhet. The Sylhet Partnership started its activity as a 'not for profit' organisation in 2001. One of the key aims of the partnership was to provide capacity building support to Sylhet City Corporation for delivering better urban environmental management services. At the outset of the project, a baseline survey was conducted by the Shajalal University of Science and Technology, Sylhet, through a Participatory Urban Appraisal with local residents and

community leaders. They identified the ten most important issues and among them collection and disposal of solid waste was identified as one of the top priorities. Consequently, a UK waste management expert was brought to undertake an initial assessment and to help the partnership to develop a waste management strategy for the city.

Following, the recommendation of the strategy paper, the Sylhet partnership started a waste management pilot project in two wards (Ward No.1 and Ward No.2) and the main business centres (Map 4.5). The aim of the pilot project was to improve the cleanliness of the city and to reduce the impact of its waste on the environment. As part of the programme, waste was collected from 2700 households, 2000 business establishments and 5 markets by 11 rickshaw vans (a locally made human paddled tri-cycle). The programme primarily relied on a European Union grant and suffered a cash flow problem immediately after the contract ended. To overcome the financial problem, the partnership started composting activities to attain self-funding capacity.

4.5.4.2 Activities of the project

The project activities were to:

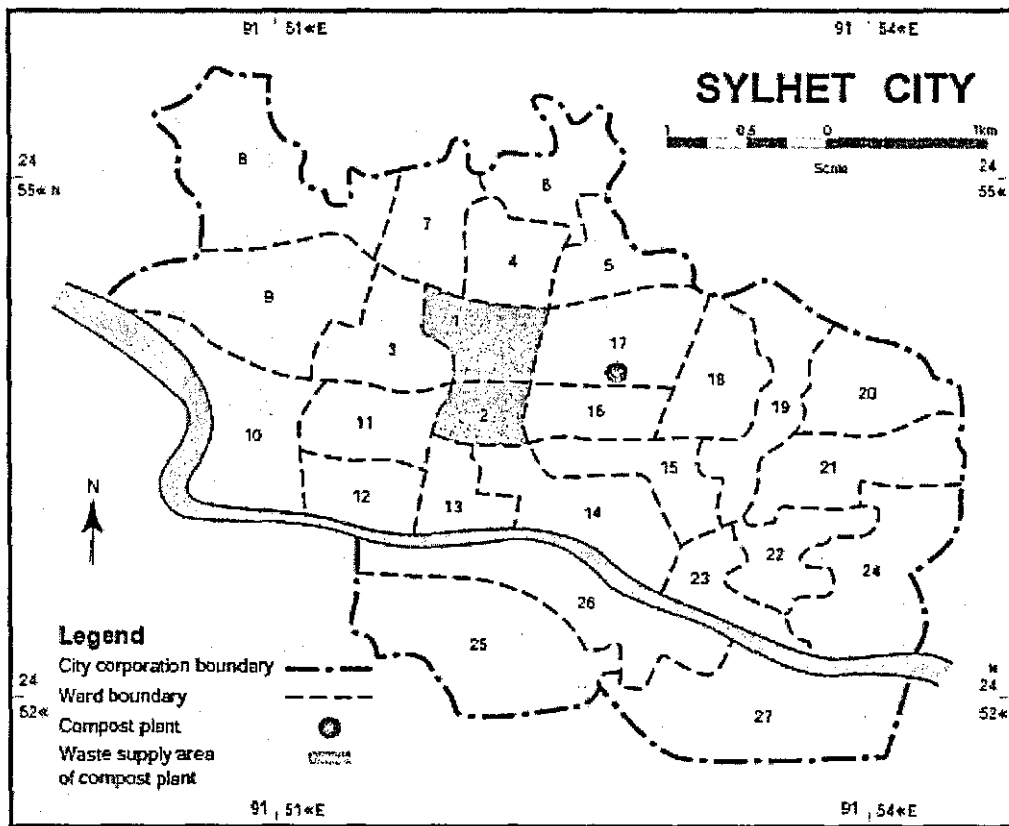
- establish waste management steering committee²⁴ to provide support and monitor the implementation of the pilot project.
- undertake consultation with households and business community groups for determining the problem areas and solutions.
- launch the 'Keep Sylhet Clean' campaign to raise public awareness through installation of street litter bins and street sign boards.
- establish a primary waste collection service and encourage residents to make a financial contribution.
- co-ordinate with Sylhet City Corporation (SCC) for secondary collection of wastes.
- introduce community-based composting for organic waste management to offset the operational cost of the project.

²⁴ The waste management steering committee comprised of representatives from SCC, Ward commissioners, NGOs, businessmen and local entrepreneurs.

- deliver a learning pack on the environment for schools to increase knowledge and awareness of the school children about appropriate solid waste management.

Key features of the project:

- The Sylhet Partnership Asia-Urbs project started with the support of a two-year European Union grant. However, when the programme ended, the partnership company faced financial hardship.
- To overcome the financial problem, it started composting with the primary waste collection service.
- The project was run on a commercial basis to become self-sustaining.



Map 4.5: Composting plant and waste collection area in Sylhet Partnership project
(Source: Sylhet City Corporation, 2003)

4.6 Conclusion

This chapter presented an overview of the community-based solid waste management in Bangladesh and in particular the background and activities of the composting projects of the four cases selected in this research. The solid waste management in Bangladesh has flourished through primary waste collection services, where communities have overwhelmingly participated in delivering waste and contributing monthly collection fees. In Dhaka, the city authority gave permission to CBOs to carry out a primary waste collection service. This permission had given them official recognition to collect charges from the community and protect them from political interference. Government agencies gave land for composting which indicated that the government was taking a facilitative role to support the community-based composting. In Khulna, city authority signed a MoU with the NGOs to give official recognition of their activities and build a close link with the community initiatives. In Sylhet, after the withdrawal of the European Union grant, Sylhet Partnership started a composting activity with the primary waste collection service. In all the projects, primary waste collection was the core activity and composting had been developed as a secondary spin-off activity. All the projects were piloted under financial support of the donor agencies. In this project phase, no capacity building activity of the community or any transfer mechanism of the project was developed. In most cases, some projects under external support succeeded in providing a lasting impact but many of them failed to continue their activities after the external support agencies ceased their support (Ogawa 2003). For the assessment of sustainability and its wider replication, the composting projects will be evaluated through key aspects: the community participation, local government attitude, financial situation, and demand and marketing of compost, in the following chapters.

Chapter 5

Community awareness and participation

5.1 Introduction

The previous chapter discussed the overview of four cases selected for this research. From the chapter it was found that the role of the community was vital in the composting projects. This chapter discusses community awareness and the participation aspect of the four community-based composting projects. 'Community awareness' means the community is activated to obtain certain objectives. In this research, 'community awareness' refers to community sensitisation which determines the level of participation of the community in waste collection and composting activities. 'Community participation' defined by Paul (1987) is *'a process where the community influences the direction and execution of a development project to enhance their well being and quality of life'*. Community participation generally explains that the community residents will not dispose of their wastes on roads or in vacant plots, but they give their waste to NGO/CBO managed door-to-door waste collection service and pay towards the collection fees in exchange. In this research context, for sustainability and replication issues, community participation will be directed towards a broader perspective where the community takes some responsibility and control over the project management for its operation.

The aspect of community awareness and participation is associated with the specific research questions:

What motivation and attitude does the community have towards composting?

What is the impact of composting on the community and how does the community accept it? What is the level of participation of the community?

In what way is the community contributing to the composting project which is likely to affect the sustainability and replication of the project?

Community motivation and attitude, community ownership, community acceptability and community contribution were selected as the indicator parameters for this aspect. Fig 5.1 presents the hypothesis; research questions and indicators in support of the role of community awareness and participation for measuring sustainability of community-based composting projects.

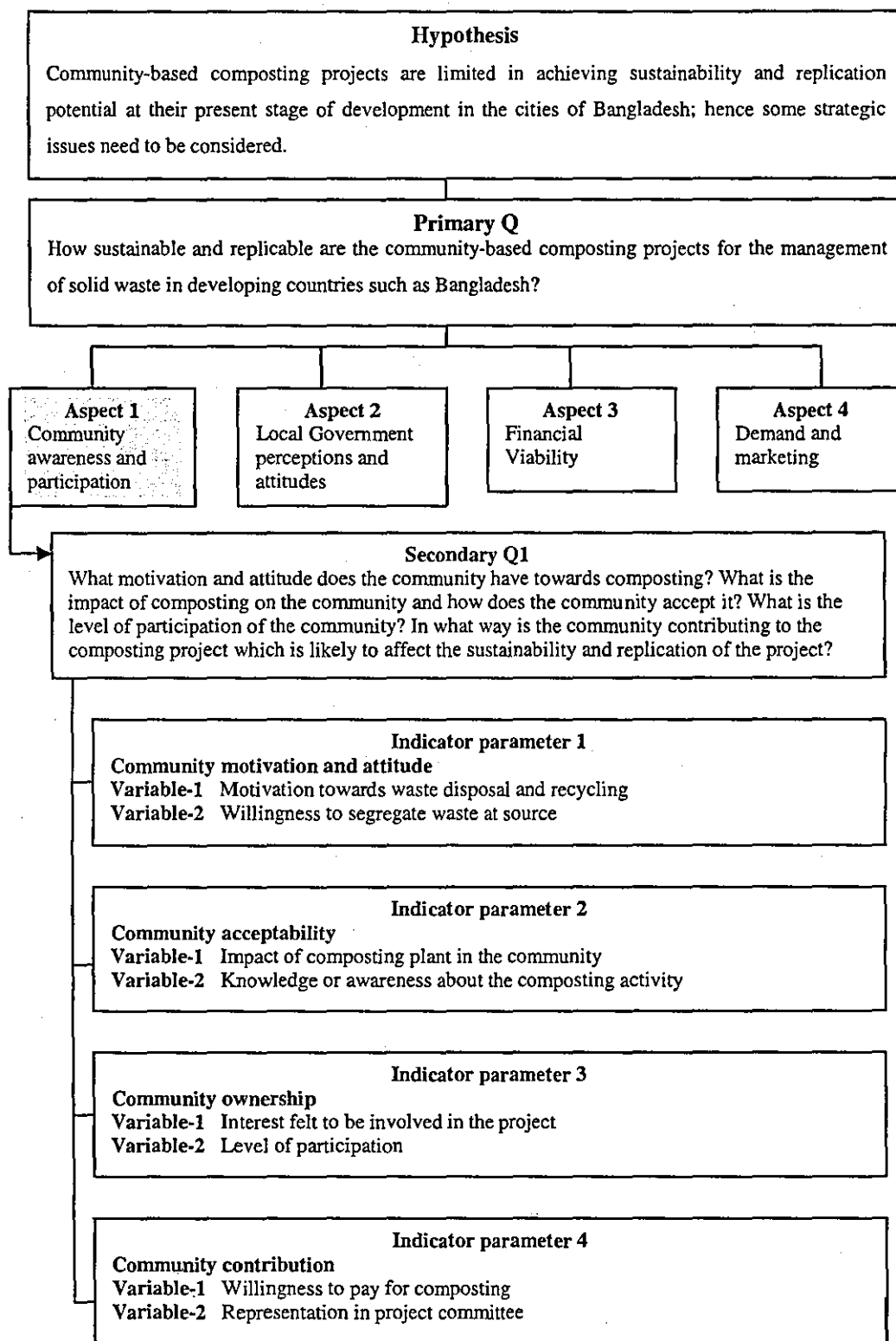


Fig 5.1: Research questions, indicators and variables for community awareness and participation.

Data and information were obtained from community household questionnaire surveys as outlined in section 3.7.2.1 of the methodology and by interviews with the

community leaders and NGO representatives. Observations and field discussion notes were also used for physical verification and cross-validity of the findings.

The quantitative data from the questionnaire surveys were analysed by using the SPSS software. The qualitative raw data from interviews were organised by ATLAS.ti 4.2, and are quoted or used in explaining statements where found applicable. A summary of the key findings and conclusions is drawn at the end of each section.

The next sections discuss the key indicator parameters relating to community awareness and participation which are defined below:

- Community motivation and attitude relates to the behavioural changes of the community members from a 'just throw' attitude to cooperation and participation in waste segregation, storage and disposal of waste.
- Community acceptability observes concerns and attitudes of the community members about siting of a composting facility close to the community setting.
- Community ownership measures the responsiveness and participation level of the community members and
- Community contribution expresses the support of the community members by willingness to pay for composting and representation on the project committee.

5.2 Community motivation and attitude

This section discusses motivation and attitude of community residents towards community-based composting. Community 'motivation' in this context refers to people's waste handling practices and perceptions achieved through mobilisation activities of the project and 'attitude' refers to the desire of the community to participate in waste collection and source-separation activities. Community motivation and attitude of community residents in solid waste management projects in practice generally means the ability of the residents to separate waste into dry and wet fractions at source, to store waste in specific bags or bins, to deliver waste to collection crews and to pay for the service. When considering the sustainability of community-based projects, community motivation can be measured by community sensitisation and mobilisation to some extent '*community to take responsibility for, to obtain authority over and to carry out control on operation and management of the*

project' (Anschutz 1996) by themselves or by engaging community organisation /NGO/private enterprise under their supervision or control.

5.2.1 Community motivation

Four cases were examined to look into community motivation towards community composting. This section is guided by the research question: **What motivation and awareness does the community have towards sustainability and replication of the composting projects?**

Community based composting project of Waste Concern

Waste Concern was operating three composting projects in Mirpur, Green Road and Dhalpur residential area in Dhaka city. The activities of the projects were to collect waste from the neighbourhood by a house-to-house waste collection service and to produce compost from the collected wastes. In these community-based composting projects, the community residents were mobilised through:

- Socio-economic surveys to ascertain the residents' willingness to participate and contribute to the waste management improvement programme of the locality.
- Formal and informal meetings with community leaders and community residents, and distribution of posters and leaflets to make them aware of the benefits of cleanliness.
- Formation of a community group (Green Force) comprised of housewives, youths and retired persons to monitor waste collection and composting activities.

These mobilisation activities increased the awareness of the community residents to some extent. Instead of disposing of waste indiscriminately, the community residents were delivering waste to the primary waste collection services in a systematic manner. People in the neighbourhoods were happy to have their waste collected at the doorstep and they were relieved from bringing waste to communal bins.

In the project activities, the community role was insignificant, confined only to representation and participation in the project meetings. There was no arrangement for capacity building of the community residents or handing over the mechanism of the

projects for their future operation which might affect the sustainability and replication possibility. It was reflected from interviews with the community leaders (Box 5.1) that Waste Concern was involved in all stages of the project activities from project planning to operation and management. At the same time, community leaders were not motivated enough to take responsibility for the project operation.

Box 5.1: Interviews with community leaders at Mirpur, Green Road and Dhalpur

The community leader of Mirpur (General Secretary of Mirpur Section-2 Household Welfare Association) opined in his interview *"We have our own business; we have no time to take responsibility of the compost plant. We do not know what will happen to the composting plant if the project fund ended. But we will keep our house-to-house waste collection programme"* [Excerpt from interview transcript M-CL].

The community leader of Green Road (General Secretary of Green Road Staff Quarter Welfare Association) said that Waste Concern did not engage their youths in the composting programme *"If Waste Concern used to train our unemployed youth and learn them the activity, they could be engaged or employed and it would create a scope to carry out the programme in future"* [Excerpt from interview transcript GR-CL].

The community leader of Dhalpur (President of DCC Staff Quarter Welfare Association) was in favour of the composting programme for the livelihood of the urban poor and said *"As some poor people are earning from our wastes, we are cooperating the project. However, if DCC conservancy workers used to get training, they could be able to run and earn from the project"* [Excerpt from interview transcript D-CL].

(Source: Field survey 2004)

From the interview with the community leader of Mirpur, it was realised that the community was not much motivated to participate in composting operations. They were interested in the door-to-door waste collection service for the removal of waste from their neighbourhood but they were not willing to take responsibility for the ultimate disposal of their wastes.

In Green Road, the community leader was in favour of employing the youths in the composting project. The youths could dedicate their time voluntarily in the community activities and could be a good human resource for the project management in future.

In Dhalpur, the opinion of the community leader towards inclusion of municipal conservancy workers in the composting operation was a positive indication towards its future operation. It might be more effective if the municipal workers were involved in the project activity of the NGO and built up their capacities. This could establish mutual trust and co-operation as well as open an opportunity for handing over the project activity to the municipality for its future operation. It may be noted that the actual design and agreement of the project was to involve the conservancy workers and ward officer in the project activities, to build their capacity so that DCC could take the management of the project in the future (Yousuf 2000). However, the agreement was not adhered to according to the original plan and DCC's participation was merely limited to providing land for the composting activity.

It can be concluded from the interviews with the community leaders that the community was not motivated to take the responsibility for the composting activity and there was no arrangement to build capacity of the community people and to take responsibility of the project in future.

To ascertain the motivational level of the community residents, community household surveys were conducted. Two questions were asked (question 13, 15 of the questionnaire in Appendix B1):

- Do you know how your wastes are being disposed?
- If yes, do you think composting is good for your community environment?

The respondents were well informed that their wastes were being recycled after delivering them to collection workers. In Dhalpur 86.0 percent, in Green Road 82.5 percent and in Mirpur 73.7 percent respondents had perceived the idea that composting was good for the environment of their community. The residents were informed about the composting activities by leaflets or by collection workers or from the demonstration workshops and meetings. A cross-tabulation of the two variables 'Ideas about waste management by composting' and 'Perception of composting as being good for the environment' showed that Pearson Chi-square significance was 0.000, which indicated that community residents perceived the idea that composting was good for their community waste management (Table 5.1).

Table 5.1: Perception of community about waste management by composting

Dhalpur Ideas about waste management by composting	Community perception about environmental improvement by community			Total (%)
	Yes	No	Partly	
Yes	37(86.0,100.0)	1(2.3,14.3)	5(11.6,83.3)	43(86.0)
No		6(85.7,85.7)	1(14.3,16.7)	7(14.0)
Total (%)	37(74.0)	7(14.0)	6(12.0)	50(100.0)
Pearson Chi-square	Value 35.960	df 2	Significance 0.000	
Green Road Idea about waste management by composting	Community perception about environmental improvement by community			Total (%)
	Yes	No	Partly	
Yes	33(82.5,97.1)		7(17.5,63.6)	40(80.0)
No	1(10.0,2.9)	5(50.0,100.0)	4(40.0,36.4)	10(20.0)
Total (%)	34(68.0)	5(10.0)	11(22.0)	50(100.0)
Pearson Chi-square	Value 28.025	df 2	Significance 0.000	
Mirpur Idea about waste management by composting	Community perception about environmental improvement by community			Total (%)
	Yes	No	Partly	
Yes	28(73.7,93.3)	5(13.2,33.3)	5(13.2,62.5)	38(76.0)
No	2(16.67,6.67)	10(83.3,66.7)		12(24.0)
Total (%)	30(60.0)	15(30.0)	5(10.0)	50(100.0)
Pearson Chi-square	Value 21.491	df 2	Significance 0.000	

The community demand or felt need for the service can be ensured if community have willingness to pay for the service (SKAT 2003). The pre-conditions for sustainability of the community-based projects are the demand for the service and project cost-sharing (section 2.3.1). More than 90 percent of the community residents were paying for the primary waste collection services. But a cross-tabulation (Table 5.2) between the variables 'Perception of composting as being good for the community environment' and 'Willingness to pay for composting' showed that the Pearson Chi-Square was not significant with the significance value for Dhalpur 0.091, Green Road 0.197 and Mirpur 0.233 (greater than 95% significance). This indicated that though the community residents perceived the idea that composting was good for their environment they were not interested in paying for the composting. In Dhalpur 36 percent, in Green Road 40 percent and in Mirpur 34 percent of the respondents were willing to pay for composting.

The low level of willingness to pay for composting indicates that the residents were more motivated for the cleanliness of their immediate environment, not for the ultimate disposal of their waste.

Table 5.2: Willingness to pay for composting

Perception about composting good for environment	Willingness to pay for composting		Total (%)
	Yes	No	
Dhalpur			
Yes	16(43.2,8.9)	21(56.8,65.6)	37(74.0)
No		7(100.0,21.9)	7(14.0)
Partly	2(33.3,11.1)	4(66.7,12.5)	6(12.0)
Total	18(36.0)	32(64.0)	50(100.0)
Pearson Chi-square	Value 4.799	df 2	Significance 0.091
Green Road			
Yes	13(38.2,65.0)	21(61.8,70.0)	34(68.0)
No	1(20.0, 5.0)	4(80.0,13.3)	5(10.0)
Partly	6(54.5,30.0)	5(45.4,16.7)	11(22.0)
Total	20(40.0)	30(60.0)	50(100.0)
Pearson Chi-square	Value 3.847	df 2	Significance 0.197
Mirpur			
Yes	13(43.3,76.5)	17(56.7,51.5)	30(60.0)
No	3(20.0,17.6)	12(80.0,36.4)	15(30.0)
Partly	1(20.0,5.9)	4(80.0,12.1)	5(10.0)
Total	17((34.0)	33(66.0)	50(100.0)
Pearson Chi-square	Value 2.911	df 2	Significance 0.233

Barrel composting project in the Slums

Waste Concern had been implementing barrel composting projects in two slums at Shah Ali Bagh and Nasimbagh in Dhaka city for more than 5 years. Barrel composting projects demonstrated resource values of the wastes and motivated housewives to carry out source separation and disposal of waste. They used to separate their wastes and put organic and inorganic wastes into different barrels. They earned a small amount of money from the compost produced in the organic barrel at intervals of 3 to 4 months. In the barrel composting projects the slum dwellers were mobilised through:

- Socio-economic surveys to know their willingness to participate in an improved solid waste management programme.
- Formal and informal discussions and meetings with the slum leaders and dwellers for cooperation.

- Hands on training to teach the housewives how to segregate waste and how to dispose of organic waste into the specially designed barrel.
- Formation of groups with a group leader for sharing the bins among 5 to 7 households.
- Involving the slum dwellers in site selection for the compost barrels.

This mobilisation was unique for its management for solid waste in the low income areas, where solid waste management had the lowest priority among the problem areas. However, it was a successful demonstration of source-separation practice and efficient management of waste within the slum areas. From a questionnaire survey in Shah Ali Bagh and Nasimbagh slum in Dhaka city (question 10 and 19 of the questionnaire in Appendix B2), it was found that sanitation and water supply were the priority concerns of the slum dwellers over solid waste disposal (Table 5.3) and the main motivation of the slum dwellers behind the participation in barrel composting was improved health and then income generation (Table 5.4).

Table 5.3 Priority problem of different services in frequency (N=60) (Scale 1 to 5, 1= Highest problem area, 5 = Least problem area)

Priority → Problem areas ↓	1	2	3	4	5	Index	Ranking
Poor drainage			18	25	17	3.98	4
Poor sanitation	32	28				1.47	1
Lack of solid waste disposal			16	17	27	4.183	5
Lack of space (Dense habitant)			26	18	16	3.83	3
Water shortage	28	32				1.53	2

Table 5.4 Motivation behind participation in barrel composting in frequency (N=60)(Scale 1 to 4 , 1= Highest priority 4 = Lowest priority)

Priority → Aspects ↓	1	2	3	4	Index	Ranking
Health	35	18		7	1.65	1
Environment		11	34	15	3.06	3
Income	25	18	8	9	2.02	2
Lack of waste management service		14	15	31	3.28	4

In the survey, the slum dwellers identified water supply and sanitation as higher priorities than solid waste management because water and sanitation services were poorly developed in the slums. The slum dwellers mentioned that they were participating in the barrel composting for their health improvement first and then for income generation. The slum dwellers were very much motivated by their health

improvement because they received health and hygiene education from different NGOs (question 22 in Appendix B2).

The project was supported by donors from the beginning. From the survey (question 26 in Appendix B2) in the slums, only 28 percent of the respondents were willing to share the project costs. This low level of willingness to share cost was due to the fact that the slum dwellers were not motivated to pay for cost of the barrel. In interviews with slum dwellers (question 27 in Appendix B2), it was found that the non-willingness to invest in barrels was due to uncertainty of settlement (22 percent) i.e. they feared sudden eviction by the government, the possibility of having the barrels stolen (33 percent) and dependency on donor/NGO fund provision (17 percent) for the waste management facility. However, the slum dwellers were regularly paying water and electricity bills.

In barrel composting, the slum dwellers were well motivated to do source-separation and disposal of waste into barrels but they were not motivated to pay for the compost barrels. In addition to the fear of losing barrels, the slum dwellers expressed their dependency on external support which indicated that slum dwellers might not continue the project, if external support is withdrawn. This highlights the importance of developing mechanisms for motivating the slum dwellers to share the barrel costs.

It was learnt from the Sri Lanka example that motivation was the main driving force to grow the willingness to pay for the service. In 'Artacharya Foundation' project in Galle, Sri Lanka, the communities were provided with bins free of charge for the first time and later obtained them via micro-credit (Rouse 2004).

Community-based composting project of Prism

The community-based composting project of Prism in Khulna city was a CBO-NGO collaboration where the CBOs were operating the primary waste collection services and Prism, was organising the composting activities. In these projects community residents were mobilised through:

- Participatory Urban Appraisal (PUA) process to determine households' perceptions of solid waste problems and their solutions, and their willingness to share costs.
- Meetings with community residents, especially women, to explain to them the negative impact of improper waste handling.

- Awareness programmes in schools, religious institutions and wards in the form of rallies, street dramas, court-yard meetings, workshops and training programmes.
- Source- separation system in three residential areas by providing two separate coloured bins.
- Formation of Waste Management Committees (WMC) and Ward Environment Development Committees (WEDC) to monitor the primary waste collection activities of the CBOs.

Prism's main target was to cover the whole city under a uniform solid waste collection and management system. It organised the primary waste collection services in 26 wards out of 31 involving 14 Community Based Organisations (CBOs). For the collection service, Prism provided waste collection vans to the CBOs and containers to the households from the project fund. Prism introduced source-separation in three residential areas and two different coloured containers were provided for this purpose. Two composting plants were constructed on rented lands as demonstration projects. 4 CBOs were supplying wastes to the plants. For monitoring the activities of the CBOs, Prism formed two committees in each service ward, one was Waste Management Committee (WMC) and the other was Ward Environment Development Committee (WEDC). Waste management committee members were involved in planning and implementation of the primary waste collection service at local level. The committees met monthly with van drivers and their assistants. They reviewed service quality of the CBOs and assisted in service charge collection. The Ward Environment Development Committee (WEDC) worked as an advisory body headed by a local ward commissioner. The committee monitored the waste collection activities of the CBOs but they were not linked with the composting activities.

From an interview with a CBO engaged in source-separated waste collection service it was reported that if they found composting to be a profitable business, they would extend their service towards composting. This indicates that CBOs might be motivated to carry out waste services from a business perspective (Box 5.2).

Box 5.2: Interview with Samas Progati Shansta, a CBO in Khulna

In an interview, Director of Samas Progati Shansta (CBO working in ward no. 14 who was supplying source-separated waste in compost plant-1) stated that *'Composting is a technical as well as commercial approach and if it is proven to be a profit making business, we will extend our service towards composting'*.

(Source: Field survey 2004)

Prism was operating the composting projects with the financial support from UNDP. As regards the future management of the composting projects, Prism had not yet designed any mechanism but it had a plan to build capacity (both technical and financial) of the CBOs for handing over the composting projects (Box 5.3).

Box 5.3 : Interview with Project Co-ordinator of Prism

According to the Project co-ordinator of Prism, *'We have a success to bring all the CBOs in one platform and to provide uniform solid waste collection and management service in the city. For the successful transfer of the composting projects, we have a plan to give training to the CBOs for operating the compost plant. We will provide initial fund and take responsibility for marketing the compost for few years until the CBOs attain full capacity'*.

(Source: Field Survey 2004)

The waste management committees (WMC and WEDC) had capacities to monitor the waste collection activities of the CBOs but composting activities were not included in their services. At this present stage of development and capacity (both institutional and financial) of the community organisations and the waste management committees, it is difficult to predict whether CBOs or the waste management committees would be able to take responsibility for whole of the composting projects. But they had high level of motivation and they were more enthusiastic about waste management activities.

Composting project of Sylhet Partnership Company

Sylhet Partnership Company was operating both the primary waste collection and the composting project with the aim of being self-sustaining in waste management. Community mobilisation activities were undertaken by:

- Consultation with households and the business community through the participatory urban appraisal (PUA) method to find out problem areas and their solutions.

- Launching ‘Keep Sylhet Clean’ campaign to raise public awareness by installing street litter bins and by displaying street signs for cleanliness of the city.
- Delivering learning packs on the environment to school children to increase their knowledge about appropriate solid waste management.

Sylhet partnership was formed from an international economic accord between Sylhet City Corporation and the London Borough of Tower Hamlets. Its main aim was to provide capacity building support to Sylhet City Corporation for delivering better urban environmental management services. The programme was supported by a European Union grant for two years. The Sylhet Partnership started its solid waste management activity with a primary waste collection service for 2700 households in two wards. It generated revenues for the service from collection charges. When the European Union grant ended, the company suffered cash flow problems. To overcome the financial problem, the partnership started composting activities with the primary waste collection service.

Key points:

- **Community was not motivated for willing to take responsibility of the composting project.**

In Waste Concern’s community-based composting projects, community residents joined the programme because of the convenience of their waste being collected from the door step. Low levels of willingness to pay for composting indicated that community residents were not motivated to take responsibility for the composting operation. They were happy with the waste collection service.

- **Slum dwellers were neither motivated nor interested to pay the cost of the barrels.**

The slum dwellers were motivated to do composting as they found resource value in it. They were regularly paying water and electricity bills. But they were not willing to pay for the barrels. They were not motivated by the NGO to pay for or to run the project independently, which subsequently developed dependency on the external support.

- **Prism was successfully organising waste collection services through the CBOs but it did not build the capacity of the CBOs or include the waste management committees to take responsibility for the composting project.**

The successful intervention of Prism was to bring all the CBOs onto one platform to maintain a uniform city-wide waste collection service. Waste management committees were formed to supervise the activities of the CBOs. Prism was operating the composting projects by itself where a number of CBOs were supplying wastes. It did not involve or motivate them in composting activities.

- **Sylhet Partnership Company was running the composting project on a commercial basis for its survival.**

The Sylhet Partnership was suffering from a financial crisis after the European Union grant ended. Composting was developed as a supporting activity of the primary waste collection service to overcome the initial financial hardship and to make the project self-sustaining.

Discussion

The community-based composting projects in developing countries are promoted by donors for achieving their socio-economic and environmental goals (Ali 2004). In these projects, primary waste collection was the main activity where composting was developed as a secondary spin-off activity to demonstrate waste reduction and recycling (Zurbrugg et al. 2003b). This was also supported by the remarks of Furedy (2004) that small-scale community composting projects may be more useful for educational purposes.

The awareness and motivational programmes of the NGOs were confined to primary waste collection services. The programmes were successful in changing the attitudes and behaviour of the community residents. They became accustomed to keeping waste properly in bags or bins and offering wastes to collection workers. But they were not motivated to be responsible for waste disposal or waste reduction or to pay for composting. Zurbrugg (2002) echoed the same view that the general environmental awareness and knowledge of the community is concentrated on health risks due to deficient solid waste management and the motivation is confined to cleanliness of their immediate environment. They hardly feel responsible for ultimate disposal of their wastes and it will be even more difficult to make them willing to pay

for disposal. From the literature, White (1987) and McCommon et al. (1990) clearly indicated that the key factors for sustainability of the community-based project are that community should have a felt-need or demand for the project and a willingness to share the project cost.

5.2.2 Community attitude

The previous section discussed awareness and motivation of the community residents about community-based composting. From the previous section, it is evident that the motivation of the community residents towards composting was low. The community residents were interested in primary waste collection services but they were less motivated to support the composting schemes.

This section discusses the attitude of community residents to doing source separation at household level. Source separation at the house refers to the practice of keeping different types of waste in designated bags/containers usually at the point of generation for the specific purpose of recycling and reuse. The purpose of source separation includes: (i) reduced risk of contamination of materials (ii) saved money and time spent on sorting materials at a recovery facility. For producing quality compost and for increasing efficiency of the process, composting has to rely on a source-segregated biodegradable waste which requires a positive and sustained attitude of the community residents.

Community based composting projects of Waste Concern

Source-separated collection of waste was not practised in the projects of Waste Concern in Dhaka city. People were not used to doing separation of waste at home as they did not have the facility or incentive to do so. Sorting of inorganic and organic waste materials was done mainly in the composting facility by the compost workers. This was a financial encouragement for the workers to make income on it. To know the willingness and interest of the community residents in source-separation, three questions were asked (question 10, 11, 12 of the questionnaire in Appendix B1):

- Will you separate your waste if a source separation system is introduced with the primary waste collection system?
- If Yes, how will you prefer to separate waste?
- If No, why you will not separate waste?

It is found from the survey that in Dhalpur, Green Road and Mirpur project area, about 70 percent of the respondents were not interested to do source-separation if source separation system was to be introduced (Table 5.5). However, respondents who were not interested in source separation, usually kept dry and clean materials (newspaper, bottles, plastic containers, old cloths etc.) separately and sold them to itinerant buyers. This indicated that households were accustomed to doing source separation of those waste materials which were apparently clean and had a direct resale value. Such separation of waste would not have any impact on ensuring collection of uncontaminated kitchen wastes and producing quality compost.

Table 5.5 : Interest in Source separation by households					
Interest in segregation	Type of segregation of wastes				Total(%)
	Wet +Dry	Dry	Wet + Dry+ Hazardous	Mixed	
Dhalpur					
Yes	12	1	2		15(30.0)
No		10(28.6,90.9)		25	35(70.0)
Total(%)	12(24.0)	11(22.0)	2(4.0)	25(50.0)	50(100.0)
Green Road					
Yes	8	3	1		12(24.0)
No		7((18.4,70.0)		31	38(76.0)
Total(%)	8(16.0)	10(20.0)	1(2.0)	31(62.0)	50(100.0)
Mirpur					
Yes	8	2	1		11(22.0)
No		5(12.8,45.4)		34	39(78.0)
Total (%)	12(24.0)	11(22.0)	2(4.0)	25(50.0)	50(100.0)

In Dhalpur among the respondents who were not interested in doing source-separation, 22 percent of them mentioned shortage of storage space in the kitchen, 16 percent mentioned inconvenience in terms of time and effort needed to put wastes in separate containers, and 32 percent mentioned that they had no knowledge about the separation or how to do it. In Green Road and Mirpur 76 and 78 percent respectively, were not interested in source-separation (Fig 5.2).

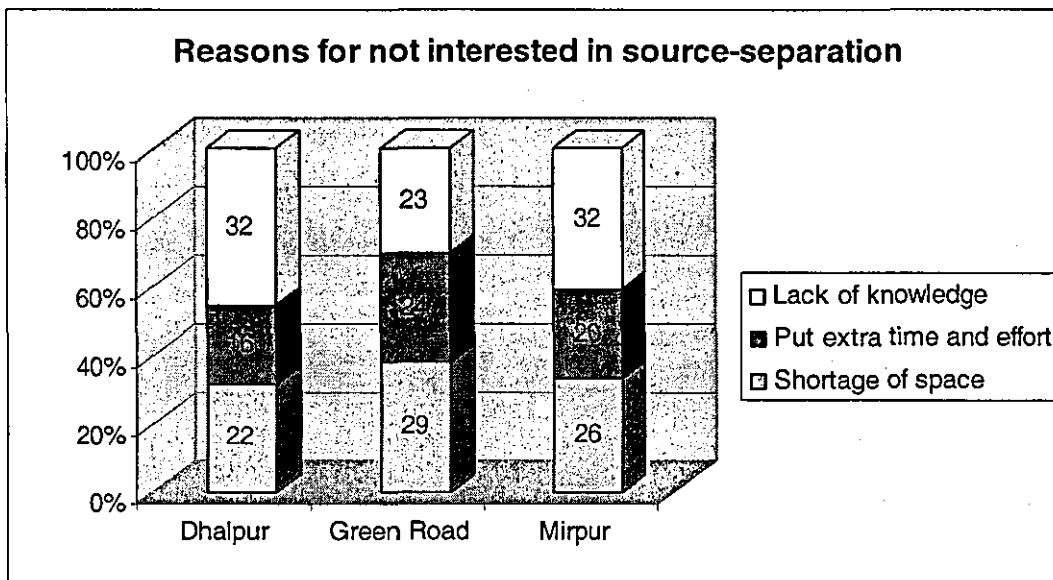


Fig 5.2: Reasons for not interested in source-separation

The literatures related to the attitudes of people who were not interested in participating in source-separation include:

- At Panaji in the state of Goa, India, 70 percent of the people were against separation of waste at home, because it was considered inconvenient to them (Selvam 1996).
- In the GRASP project at Pune, India, some households did not want to participate in waste separation because they thought it was time consuming and unpleasant work (Raman 1995; Ali and Snel 1999).
- There is a stigma attached to the separation of waste at home; this may be for socio-economic, psychological, cultural or religious reasons (Daskalopoulos et al.1997).
- Orthodox Muslim and Hindu religion people feel themselves impure if they touch waste (Medina 2000).
- In Dar-és-Salaam city, the source-separation failed because it was not culturally acceptable to the citizens (Kaseva and Gupta 1996).

From the respondents' views in the surveys and the literature review, it can be concluded that source-separation of waste is a long drawn out exercise as it needs attitudinal changes of people. In the present socio-cultural perspective, keeping organic waste free from contamination would be a difficult job as households are not

accustomed to keeping waste separately in the kitchen and they perceive waste as dirty and will make them impure if they touch it.

Barrel composting project in slums

Source-separation of waste was widely practised by the slum dwellers in the barrel composting project. Two different coloured barrels were supplied, one for organic and the other for inorganic waste. The organic barrel was normally shared by 5 to 7 families and the inorganic barrel was shared by 10 to 15 families. Housewives of the slums used to do separation into organic and inorganic wastes in the kitchen and put them in the designated barrels. After 3 or 4 months, when the barrels became full, the housewives unloaded the decomposed wastes and gave it to the NGO. In return they used to get some money which was shared among the group members.

Barrel composting in the slums was a new concept of waste disposal. At the beginning, the social mobilisers visited every household in the slums and explained to them the need for waste segregation and the benefits of waste recycling and recovery. Very simple visual aids such as posters, video-films and photographs were used and practical demonstration was given to the housewives to teach them how to segregate and dispose of their wastes in the designated barrels.

From this case, it can be learned that economic incentives and provision for keeping wastes separately could influence household behaviour. This is supported by the following literatures:

- In the Philippines households were encouraged to do source-separation because they were provided with the proceeds from the sale of recycled materials as an incentive (Camacho 1993).
- In SIDRO recycling project at Mexico, it was anticipated that economic benefits would have an influence on the proper behaviour of household level separation (Lardinois and Klundert 1993).
- In Indonesia, a household level waste separation programme for composting failed because most of the households felt discouragement as there was no financial incentive for participation in waste separation (Mockler 1998).

Community based composting project of Prism

Prism started source-separation in 3 wards (Ward No.14, 19 and 24) to develop practice only. Prism provided the residents with information leaflets with pictures which made the separation process easy to understand. In addition, community supervisors gave practical training on source separation to housewives and maidservants. Two different coloured containers were provided. A red container was for inorganic waste which was collected once a week and a green one for organic which was collected every day. According to the interview with the Project Co-ordinator of Prism, *'for developing practice and for knowing the response from the residents, we first introduced source-separation in three residential areas (286 households in Majgunni residential area of ward no. 14, 300 households in Nirala housing estate of ward No. 24 and 350 households in Dalmilmore of ward no. 19). We found active participation of the households. The other residential areas are also demanding for introducing the system in their areas'*.

The encouraging response and requests received from other communities to launch similar programmes in their communities were positive indicators of the success of the programme. Provision of the containers and a fixed waste collection schedule obliged the residents to do source-separation.

Key points

- **In the present socio-cultural perspective, keeping organic waste free from contamination is a difficult job as households are not accustomed to keep waste separately in the kitchen.**

In Waste Concern's community-based composting projects, source-separation of waste was not practised. Waste sorting was mainly done in the composting facility by the workers. From the community household surveys, it was found that willingness to perform source-separation was low. The reasons for un-willingness of the residents to do source-separation were: shortage of space in the kitchen; lack of enthusiasm of the residents to put extra effort and time for separation; and lack of knowledge about the separation and how to do it.

- **Economic incentives for separating waste at household level can influence household behaviour.**

In barrel composting projects, the slum dwellers used to separate organic and inorganic wastes and put them in designated barrels. Barrel composting was a new concept of waste disposal where waste could be converted into compost. It was a source of income generation for the slum dwellers. The household motivation towards the resource value of wastes significantly changed the attitude of the slum dwellers.

- **Awareness and provision of containers may influence the practice of source-separation.**

In the Prism project, source-separation was introduced in three residential areas only to develop the practice among the residents. It was successfully implemented because the housewives and maidservants were provided with practical demonstrations of which materials could be sorted out and how they could be sorted. Households were supplied with different coloured containers and separate waste collection schedules were fixed by the project.

Discussion

Source-separated waste materials can facilitate the production of high quality compost with a minimal concentration of physical and chemical contaminants. It also facilitates waste reduction, saves sorting time in the compost facility and increases the working efficiency of the composting process (Furedy 2002; Zurbrugg and Aristanti 2000). According to Furedy (2004 p-204), '*The long success of urban organic waste composting seems to be reliant on source-separation*'. Source-separation requires the cooperation and motivation of the waste generators. In the Prism project at Khulna, source-separation of waste was possible because separate containers were provided and waste collection schedules were fixed on different dates. In addition, social organisers were employed to give practical demonstration to housewives and maid servants. Pervez (2004) mentioned that source-separation had failed in the Waste Busters community waste management project in Lahore, Pakistan. Households did not bother to segregate or put separate wastes in designated bins even though separate bins were provided. This was because households were not provided with the knowledge why, and how waste could be separated; also which parts of the waste could be reused.

In the barrel composting project, the slum dwellers were motivated to do source-separation because it was an income generating activity for them.

It can be concluded from this section that source-separation at household is the only way to improve safety and efficiency of the composting project. It requires awareness, knowledge and attitudinal changes of the waste generators. In the present socio-cultural perspective, it is difficult to change the attitude of the households to practise source-separation without providing financial incentives or separate collection arrangements which are likely to affect the efficiency as well as long term sustainability of the composting projects.

5.3 Community acceptability

The previous section discussed the community motivation and attitude towards community-based composting projects. It can be concluded that the present level of community motivation is not in support of composting and in the current socio-cultural climate the attitude of the residents is not supportive of source-separation unless incentives or facilities are provided. This section discusses acceptability of the composting facility by the community. Community acceptability can be used both in a positive and a negative sense. 'Acceptance' signals a positive response, while 'rejection' stands for an opposed attitude. In this research 'acceptability' refers to the tolerance level of the community residents as a measure of the community reaction towards municipal solid waste composting. Two variables were chosen to know the concern of the community residents about composting (i) Impact of composting plant in the community (ii) Knowledge or awareness of the community about composting activities.

Community based composting of Waste Concern

Waste Concern built four composting plants in Dhaka city at Mirpur, Green Road, Dhalpur and Baily Road. After a few months of operation, the Baily Road plant ceased composting activity. The other three composting plants were operational.

In order to assess community concern and attitude towards acceptability of composting facility in the community, two questions were asked (question 16, 17 of the questionnaire of community survey in Appendix B1) of the community residents:

- What benefits are you getting from composting?

- What are the negative impacts of composting in your community?

The respondents identified four positive observations. These were fewer wastes on the streets, no overflow of wastes from community bins, less fly and mosquito breeding and no odour from rotting waste. From the cross-tabulation (Table 5.6) of the variables 'Perception of composting as good for the community environment' and 'Observation of improvements in the community after composting' it was found that fewer wastes on the streets and no overflow of wastes from community bins were the significant positive impacts of the composting project as the Pearson Chi-square significance was less than 0.05. The other observations, less mosquito and fly breeding, and no odour were not very significant.

Table 5.6 Observation of improvements in the community after composting												
Perception of composting good for community environment	Fewer waste on the street			No overflow of waste from community bins			Less mosquito and fly breeding			No odour		
	Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total
Dhalpur												
Yes	29	8	37	19	18	37	13	24	37	15	22	37
Partly	2	4	6	2	4	6	3	3	6	1	5	6
Total	31	12	43	21	22	43	16	27	43	16	27	43
Pearson Chi-square	Value 5.207 df 1 Significance 0.022			Value 0.671 df 1 Significance 0.413			Value 0.488 df 1 Significance 0.485			Value 1.259 df 1 Significance 0.262		
Green Road												
Yes	21	13	34	19	15	34	19	15	34	19	15	34
Partly	5	6	11	10	1	11	4	7	11	4	7	11
Total	26	19	45	29	16	45	23	22	45	23	22	45
Pearson Chi-square	Value 0.906 df 1 Significance 0.343			Value 4.450 df 1 Significance 0.035			Value 1.267 df 1 Significance 0.260			Value 1.267 df 1 Significance 0.260		
Mirpur												
Yes	16	14	30	21	9	30	12	18	30	21	9	30
Partly	5		5	1	4	5	3	2	5	5		5
Total	21	14	35	22	13	35	15	20	35	26	9	35
Pearson Chi-square	Value 3.889 df 1 Significance 0.049			Value 4.589 df 1 Significance 0.032			Value 0.700 df 1 Significance 0.403			Value 2.019 df 1 Significance 0.155		

Despite the positive benefits of composting, some of the respondents indicated negative observations, such as bad smell or odour, breeding ground for insects and vermin, and local hazard or nuisance, as problems due to composting in the community (Fig 5.3). In Dhalpur, 7 respondents out of 50 had negative observations about composting. Among the 7 respondents; 4 mentioned about bad smell, 2 of insect and vermin infestation and 1 of local hazard or nuisance. In Green Road, 5 respondents and in Mirpur 15 respondents viewed composting activity in a negative light.

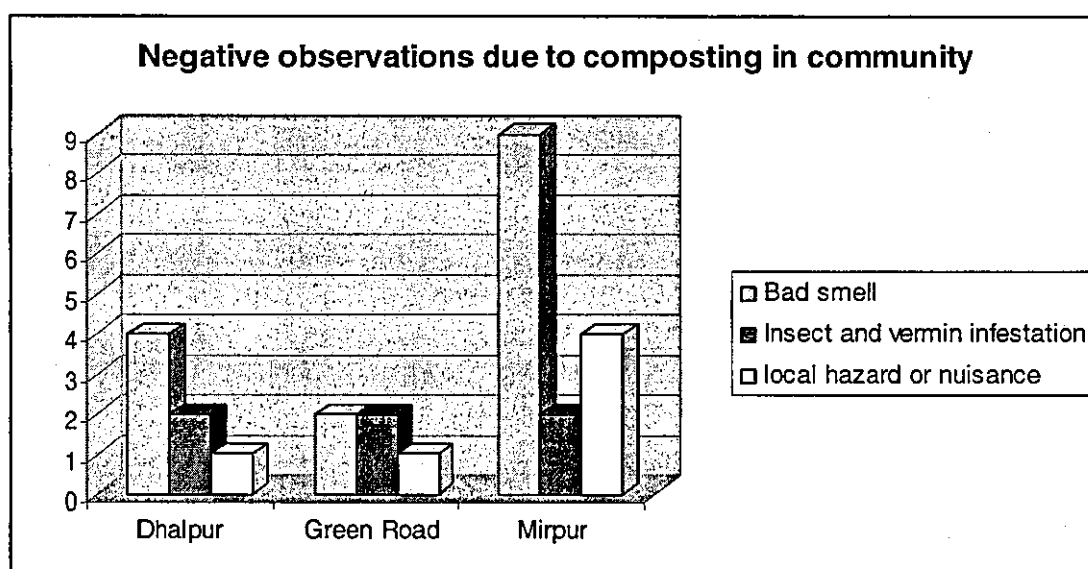


Fig 5.3: Negative impact of composting in community

The odour complaint from the nearby residents was a challenge for the composting facility in the community. The perception of bad smells or odours largely depends on the sensitivity of the person and the type of gas being released from the waste facility. Many malodorous chemicals such as Ammonia (smells like raw sewage), Methyl Mercaptan (smells like rotten onions), Trimethylamine (smells like rotten fish) and Hydrogen sulphide (smells like rotten eggs) are intermediates in the composting process [JICA 1999]. The odour complaint from the community largely depended on the community set-up and its distance from the composting plant.

Cross-tabulation (Table 5.7) of the variables 'Perceptions of composting as good for the community environment' and 'bad smell or odour from the composting facility' showed that the Pearson Chi-square values for Dhalpur 0.010, Green Road 0.033 and Mirpur 0.000 were significant (smaller than 0.05). This indicated that in the

composting facility odour was not a significant factor when the community perceived composting as good for community waste management.

Table 5.7 Cross-tabulation for bad smell or odour from compost plant and perception of composting as good for community environment				
Perception of composting good for community environment	Bad smell or odour from compost plant			
	More frequently	Less frequently	No smell	Total row (%)
Dhalpur				
Yes		22	15	37(74.0)
No	2	5		7(14.0)
Partly	1	2	3	6(12.0)
Total column (%)	3(6.0)	29(58.0)	18(36.0)	50(100.0)
Pearson Chi-square	Value 13.221	df 4	Significance 0.010	
Green Road				
Yes	2	13	19	34(68.0)
No	2	3		5(10.0)
Partly	1	7	3	11(22.0)
Total column (%)	5(10.0)	23(46.0)	22(44.0)	50(100.0)
Pearson Chi-square	Value 10.479	df 4	Significance 0.033	
Mirpur				
Yes		8	22	30(60.0)
No	3	12		15(30.0)
Partly		1	4	5(10.0)
Total column (%)	3(6.0)	21(42.0)	26(52.0)	50(100.0)
Pearson Chi-square	Value 25.592	df 4	Significance 0.000	

In another cross-tabulation (Table 5.8) of the two variables 'bad smell or odour' with 'distance of compost plant from the community' identified as a null hypothesis (there is likely to be no relationship between distance of the composting facility and the bad smell or odour) was rejected by the Pearson Chi-square test at Dhalpur and Mirpur as the significance levels were 0.036 (smaller than 0.05). However, in Green Road the significance level was 0.474 (larger than 0.05) i.e. the null hypothesis was accepted. This indicated that in case of Green Road, perceiving bad smells had no relationship with the location of composting facility. The observation 'The closer the community is to the compost facility, the more odour complaints may arise from the community' is prominent in the cases of Mirpur and Dhalpur because the community was not consulted during siting of the composting facility. At Green Road, the odour complaint was less because community members were involved during site selection. It can be concluded that the prevention of complaints of odours from the composting

facility could be minimised by the involvement and participation of community residents in site selection and consultation.

Table 5.8 Cross-tabulation for bad smell or odour with distance from compost plant				
Distance of household from compost plant	Bad smell or odour from compost plant			
	More frequently	Less frequently	No smell	Total row (%)
Dhalpur				
<300m (4%)		1	1	2(4.0)
300-500m (60%)		22	8	30(60.0)
>500m (36%)	3	6	9	18(36.0)
Total column (%)	3(6.0)	29(58.0)	18(36.0)	50(100.0)
Pearson Chi-square	Value	df	Significance	
	10.275	4	0.036	
Green Road				
<300m (88%)	5	19	20	44(88.0)
300-500m (12%)		4	2	6(12.0)
Total column (%)	5(10.0)	23(46.0)	22(44.0)	50(100.0)
Pearson Chi-square	Value	df	Significance	
	1.491	2	0.474	
Mirpur				
<300m (47%)		14	10	24(48.0)
300-500m (51%)	3	7	16	26(52.0)
Total column (%)	3(6.0)	21(42.0)	26(52.0)	50(100.0)
Pearson Chi-square	Value	df	Significance	
	6.649	2	0.036	

Acceptability of a solid waste management facility in the community needs dialogue with neighbourhoods or their involvement in the planning process; otherwise there may be opposition from the community against the facility. In Baily Road Officers' Quarter, a community waste collection and composting project started in 2001 stopped its activity after four months due to objections raised by the residents of the nearby building. A questionnaire interview was conducted with the residents of 15 out of 36 flats of the nearest building (Appendix B3). From the survey, it was found that 80 percent of the respondents complained, out of them 40 percent mentioned about bad smell, 20 percent about nuisance and the remainder about mosquito and fly breeding. The respondents opined that they were not informed during selection of the project site. Though the NGO stopped its composting activity after the objections raised by the community residents they agreed to continue the door-to-door waste collection service and the households were paying waste collection fees regularly. A cross-tabulation for the significance of consultation during construction of the composting facility and complaints raised by the nearby residents was found positive by Pearson Chi-square value (Table 5.9). It indicated that community residents tend to

show more negative attitudes or displeasure if they are not informed of the project activities.

Table 5.9 : Cross-tabulation for consultation during facility construction and complaints against the facility siting at Baily Road						
Consultation during installation of the plant	Bad smell		Nuisance		Mosquito and fly breeding	
	Yes	No	Yes	No	Yes	No
Yes		1		1		1
No	6		3		3	
Total (%)	6(40.0)	1	3(20.0)	1	3(20.0)	1
Pearson Chi-square	Value 7.000 df 1 Significance 0.008		Value 4.000 df 1 Significance 0.046		Value 4.000 df 1 Significance 0.046	

Compost plant siting is an important issue in order to avoid public complaints about unpleasant odours or nuisance. Consultation during facility siting and raising awareness among the community residents about the composting activity might have a positive impact on the project. Community acceptance or community objection i.e. the NIMBY²⁵(Not In My Back Yard) attitude is vital as it is likely to influence the continuity of the community-based project. If the community does not have knowledge about the activity of the project or they lack access to information, they may raise objections to siting the facility in the community. Therefore, appropriate information disclosure is an important factor in acceptability of a composting facility in the community. In Waste Concern's composting projects, the programme was communicated to the community residents by means of brochures, posters, meetings and clean-up campaigns. Community consultation at the planning stage and follow-up meetings during the project operation can make people understand the activity and can thus increase their acceptability level.

Barrel composting project in slums

The barrel composting project was the first intervention in the slum and squatter settlements to involve the urban poor in the management of their own solid wastes. In Shah Ali Bagh slum the location of the barrels was selected from a ground map in consultation with the slum leaders and dwellers. Some of the bins were placed very

²⁵ NIMBY- An expression of resident opposition to the siting of solid waste facility based on the particular location proposed.

close to the houses (within 5 to 10 feet) and other were placed over the drains, in passages or even in front of the houses (Field observation 2004 and location Map 4.2). The households had been operating the barrels for more than 5 years which indicates that the slum dwellers accepted the barrel composting project.

The Nasimbagh slum was on a privately owned property. The houses were rented and the water, sanitation and other infrastructure services were provided by the landlord. For the solid waste service, the NGO Waste Concern communicated with the landlords and selected the barrel locations.

From the questionnaire survey (question 18 of the questionnaire in AnnexureB2), the slum dwellers identified leaching from the barrel, odour, insect infestation, space constraints and external intervention as problems with the barrel composting process. It can be concluded that along with the other problems, though placement of barrels in the walkway was inconvenient for the slum dwellers but they continued the barrel composting projects for more than five years which indicated their overall satisfaction with the project.

Sylhet Partnership Company composting project

The Sylhet partnership constructed the composting plant on rented land at Shamimabad (ward no.16) which was outside of the waste collection areas (ward no.1 and ward no.2). When the nearby residents were interviewed to find views on the composting project, they raised complaints about nuisance and odour from the facility and hazards from the movement of waste collection vans in their residential area. The opinions of the residents were not taken into consideration before construction of the plant. During construction, they were informed that it would be a fertiliser factory but the waste handling matter was not disclosed to them. They were so unhappy with the project activity that they were not even interested to join the waste collection service under the said programme.

Key points and discussion

- **Low level of community involvement in project planning and implementation and lack of knowledge and awareness of the community about the composting process and its possible impact are the constraints to the continuation of the composting project.**

In Waste Concern's community-based composting project, it was found from community household surveys that community residents positively endorsed waste composting as good for their community environment as they could see less wastes in the community streets. Some other respondents viewed community composting as an aesthetic disorder and nuisance in the community.

In Dhalpur and Mirpur the composting sites were donated by Dhaka City Corporation and Lions Club (a local charity), where there was no scope for community consultation. In these cases, odour complaints were found from the nearby community in the household surveys. In Green Road, the location of the compost plant was selected in consultation with the community residents and odour complaints were found to be less. In Baily Road, after only a few months, the facility stopped composting operations due to the nuisance and odour complaints from the nearby residents.

Siting of the compost facility is an important factor. The compost facility needs to be sited reasonably close to the input stream to save waste transportation costs but it must be compatible with the desires of the nearby community (UNEP-IETC 1996). The sustainability of a community-level scheme depends on cooperation and support of the community households with regard to willingness to accept the facility in the neighbourhood. Composting facilities are associated with some environmental and social concerns such as odour and nuisance. MacDonald (2004) stated that facility siting can influence the success or failure of a composting project in terms of environmental and social impacts. Some of the examples of resistance to compost facility siting in the community are:

- The composting activity in Hyderabad, India by the NGO SPEQL was hindered by opposition from neighbourhoods who complained about smell and flies (Colon 2004).
- Teku compost plant in Kathmandu, Nepal, stopped activity in 1991 due to local residents' opposition on environmental pollution grounds (UWEP 1996).
- In Hyderabad, India a composting plant undertaken by the Reddy Foundation in a neighbourhood park allocated by the Municipal Corporation of Hyderabad was suspended due to complaints about vermin and stench from the facility. Afterwards, another NGO Sukuki Exnora took the scheme, shifted the location

to a centralised place and treated largely market waste and was running efficiently (Galab et al. 2004).

To increase acceptance or tolerance level of the community residents, consultation or involvement of the community during planning and implementation of the project is essential. Better communication and information accessibility with community residents may increase credibility and acceptability of the project (Rahardyan et al. 2004). In Sao Paulo, Brazil the Mayor gave a piece of land to a waste pickers' co-operative for sorting and recycling. In the beginning, the neighbourhood communities objected but after an open day and several meetings they were convinced (Klundert and Lardinois 1995).

From the analysis, it was found that the statistical correlation 'the closer the community is to the compost facility, the more complaints of odours or nuisances are likely to be received from the community' is not always practical if the community is aware of the process and its impact. Rahardyan et al. (2004) felt that to avoid public complaints about nuisance and odour, special attention was needed to minimise such complaints and community residents should be provided with appropriate knowledge about the activity. The statistical results from a survey conducted by the University of New Hampshire on the public's reaction to siting a municipal solid waste composting facility indicated that distance and a high level of household involvement in waste management (recycling and source reduction) positively influenced the acceptance of such a facility in the community, while perceived environmental impacts (i.e. odour, nuisance) were against the facility siting (Halstead et al. 1994). Waite (1995) reported that community acceptance can be adopted by (i) keeping the site tidy (ii) publicising the facility locally. This will increase attention of the public and avoid complaints about unpleasant odours and nuisance.

- **Selection of site with a consensus view of the users and incentives bring support to the project.**

In the barrel composting project, slum dwellers were operating composting by themselves. In Shah Ali Bagh slum, location of the barrels was selected in consultation and participation with the slum leaders and slum dwellers. Some barrels created inconvenience to the movement of slum dwellers. But the slum dwellers accepted the problem and had been participating in the project. Barrel composting was an income generating project for the slum dwellers. They got some financial

benefits which inspired them to participate in the project. Waite (1995) supported the view that community acceptance and participation could be ensured by providing a share of the proceeds from the sale of compost to community residents.

- **Composting projects must be sited so as to be compatible with the desires of the nearby community, and communication with the community residents should be improved and all necessary information about the project should be provided to them.**

In the Sylhet Partnership composting project, the waste management activity was not disclosed to the nearby residents. They were unhappy and asked for the plant to be moved from their community. They showed no interest even in participating in the waste collection service under the programme. Zeiss and Atwater (1991) mentioned that residents tend to show more negative attitudes if they unfamiliar with the facility and they lack accessible information. Tchobanoglous et al. (1993) further confirmed that appropriate information disclosure or accessibility to information is an important factor for acceptability of the waste management facility.

5.4 Community ownership

The previous section discussed acceptability of the composting project in the community. It can be concluded from the section that when composting facilities are constructed with the consensus view and opinion of the community, this will create a feeling that the facility belongs to the community. To make the community residents more responsive, it is worthwhile involving them in project monitoring and maintenance of the project. This section discusses the importance of ownership of the community composting project for its sustainability. According to Craig and Mayo (1995), ownership means self-esteem and builds up confidence. It may be achieved through a process of delegating power and allowing more direct control over services. Ownership in this research context refers to community feelings of responsibility for the service. Involving the community in project planning and implementation may increase a sense of ownership of the project and enhance a sense of responsibility for maintaining the service of the project. This may support project longevity and continuity. Two variables were chosen (i) interest felt by the community residents to be involved in the project (ii) level of participation of the community residents. In a

community-based composting project, community residents can participate in different ways by properly separating and keeping wastes in the kitchen, delivering wastes at the appropriate time and paying collection fees. To a further extent the community can participate to influence the decision making process or they can be part of the project to take authority or control over the project management (Anschutz 1996).

Waste Concern's community composting project

In the community composting projects of Waste Concern, community residents were mobilised through inception workshops, visual presentations and written materials. Their participation was limited to waste delivery and paying collection charges. Waste Concern was in charge of management and operation of the programme. There was no scope for the community members to be involved in project activities from planning to implementation, which was a passive form of community participation (section 2.7, Box 2.2). Community was not delegated to take authority or decision making power of the project. Community participation was limited only to financial contributions and to attendance at project meetings. They had no direct or indirect control over the operation and management of the project. At this level of participation, a community can hardly perceive the importance of ownership or feel themselves responsible. According to Arnstein's ladder of community participation (1969), mobilisation and awareness raising are the non-participation stage of community participation. Information, consultation, decision making, delegating authority and control over the project are the most effective levels of community participation (Wilcox 1994). In Waste Concern's project, community participation was limited to the mobilisation and awareness stage of the Arnstein's ladder of community participation, which was less effective and marginal in developing a sense of ownership and responsibility. In the Patan conservation and development project in Kathmandu, Nepal the participation of the community in the decision making process had generated ownership feelings and they were more concerned and aware of the various implications of solid waste handling in their community (UWEP 1996). In Cipinang Besar, a neighbourhood in East Jakarta, the control of the composting project empowered the community to meet their own social and environmental needs and thus created a sense of responsibility (Perla 1997). It is proven from the examples that when people can participate in the

decision making process and can influence or control the decisions, they may be inspired to work harder to ensure its success.

From the interview with community leaders it was found that community residents were satisfied with having a waste collection service in their community. They had their own jobs and had limited scope for putting effort in and time to project activities (Box 5.1). The sense of ownership does not only mean that the community is aware of the project or enjoying the project benefits but to some extent the community should give time and effort and should be involved in the decision making process (Sohail et al. 2001).

Community participation is a voluntary activity. A felt need and willingness of the community to pay money is a real test of ownership (Sohail et al. 2001). In Bangalore, the residents of the initiative used to purchase and use compost as organic fertilisers in their gardens as a contribution to the project financing (Zurbrugg et al. 2003b). To measure ownership of the project by community residents, two questions were asked (question 21, 23 of the questionnaire in Appendix B1).

- Have you purchased or used compost from the composting plant in your garden?
- Will you pay for the composting activity?

A cross-tabulation on the idea about waste composting and willingness to purchase or use compost and pay for the composting showed that Pearson chi-square values for Dhalpur, Green Road and Mirpur were not significant. This indicated that community residents were not interested to extend financial support or to feel responsible for the composting project (Table 5.10). Among the respondents who had some idea about waste composting; in Dhapur 90.0 percent, in Green Road 92.0 percent and in Mirpur 84.0 percent felt no interest in buying or using compost. Regarding the willingness to pay for composting the respondents were divided into Dhalpur (Yes 36.0 percent) No (64.0 percent); in Green Road (Yes 40.0 percent) No (60.0 percent) and in Mirpur Yes (34.0 percent) No (66.0 percent). This level of desire for payment reflects the fact that the project was not planned in accordance with the demands and priorities of the community residents.

Table 5.10 : Cross-tabulation for idea about waste composting and willingness to purchase or use of compost and pay for composting

Idea about waste composting	Purchase or use of compost			Pay for composting		
	Yes	No	Total (%col)	Yes	No	Total (%col)
Dhalpur						
Yes	5	38(88.4,84.4)	43(86.0)	18(41.9)	25(58.1,78.1)	43(86.0)
No		7	7 (14.0)		7	7 (14.0)
Total (% row)	5(10.0)	45(90.0)	50(100.0)	18(36.0)	32(64.0)	50(100.0)
Pearson Chi-square	Value 0.904	df 1	Significance 0.342	Value 3.278	df 1	Significance 0.082
Green Road						
Yes	4	36(90.0,78.2)	40(80.0)	17(42.5)	23(57.5,76.7)	40(80.0)
No		10	10(20.0)	3	7	10(20.0)
Total (% row)	4(8.0)	46(92.0)	50(100.0)	20(40.0)	30(60.0)	50(100.0)
Pearson Chi-square	Value 1.087	df 1	Significance 0.297	Value 2.438	df 1	Significance 0.193
Mirpur						
Yes	8	30(78.9,71.4)	38(76.0)	16(42.1)	22(57.9,66.6)	38(76.0)
No		12	12(24.0)	1	11	12(24.0)
Total (% row)	8(16.0)	42(84.0)	50(100.0)	17(34.0)	33(66.0)	50(100.0)
Pearson Chi-square	Value 1.808	df 1	Significance 0.183	Value 3.288	df 1	Significance 0.085

Barrel composting project in slum

In the barrel composting project, the slum dwellers were involved in both the selection of barrel locations and the composting operation. After a period of 3 to 4 months, the slum dwellers emptied the barrels and gave the decomposed materials to Waste Concern. After 5 to 6 months Waste Concern gave money to the slum dwellers from the sale proceeds. Two observations were found. One was during construction of the barrels Waste Concern employed outside labourers and they did not involve the slum dwellers in compost selling. Another was slum dwellers demanded lockable covers from the NGO to prevent unwanted wastes in the barrels, which proved the acceptability of the project by the slum dwellers (Field report 2004).

The slum dwellers found incentives to operate the compost barrels as they could earn money from the project. This grew a sense of ownership of them to some extent which was confirmed by the demand for lockable systems for the barrels to prevent unauthorized intervention.

Community composting project of Prism

In Prism's project, 14 CBOs were involved in house-to-house waste collection services in 26 wards. Their main target was to carry out city-wide primary waste collection services in a uniform manner. For better monitoring and co-ordinating the activities of the CBOs, Prism formed two committees. One was the Waste Management Committee (WMC) in the lowest level (block) and the other was the Ward Environmental Development Committee (WEDC) in all working wards. For waste reduction and recycling, Prism constructed two composting plants. Out of the 14 CBOs, only 5 were supplying wastes to the compost plants. CBOs were empowered to motivate and organise local residents. The committee members were engaged in planning and implementation of the waste collection activities. They used to attend monthly meetings, review the quality of the service, assist the CBOs in collecting service charges and motivate the non-participating households. This indicates that ownership feelings were being created among the community representatives. The waste management committees had administrative structure and were empowered to take decisions on waste management activities. But these committees' functions were confined to monitoring and supervision of the waste collection services, and not extended to the composting activities.

Key points and discussion

- **Low level of involvement or empowering of the community residents in project activities does not develop responsiveness or a sense of belonging to the project.**

In Waste Concern's community-based composting projects, the community participation was limited to handing over waste to collection workers and paying service charges. The operation and management of the projects was under Waste Concern's direction. There was no scope for the community to be involved in any phases (planning to implementation) of the project. Community engagement in the project was confined to the mobilisation and awareness building stage which was the lowest level of Arnstein's ladder of community participation- the non-participating phase. From the experience of Patan conservation and development project in Kathmandu, Nepal it was reiterated that for sustaining the operation of the project, the community has to build capacity and develop greater access to authority (UWEP

1996). In the Karachi solid waste management project, sustainability was achieved as the community was involved in all phases of the project including assessment of the existing situation, design, implementation and management of the system (Ahmed 2003).

In Waste Concern's composting project, there was no provision for capacity building of the community residents or they were given the authority to look into the project activities. Ahmed (2003) laid emphasis on training and capacity building of the community members. In Karachi, Pakistan a Local NGO- Association for Protection of the Environment (APE) trained a few members of the local Community Based Organisation (CBO) to manage and run the project on an independent basis which empowered the communities to develop their own services in the absence of external support.

Sohail et al. (2001) pointed out that community residents will pay for the service, when they feel responsible for the project. From the statistical significance, it was found that a low level of willingness to share the cost of composting operations and use compost in gardens by the community residents indicated the community's low level of responsiveness or sense of belonging to the project.

The literature review (section 2.7, Table 2.1), clearly indicated that when the community plays only a marginal role in project development and operation, and an external agency is almost in charge of development, such a level of participation is seldom sufficient for the community to develop a sense of ownership and responsibility or to develop the capacity or ability to operate the project in future. This type of project may not be sustainable or replicable.

- **Slum dwellers had positive feelings for the project as they were involved in selection of the barrel locations. Unless they have both the financial and management authority over the project, they will feel less responsible for the project.**

In the barrel composting project, a participatory process was adopted during selection of the barrel locations, which was effective in creating community ownership and obtaining consensus views of the slum dwellers. The engagement of local people in the composting process increased a sense of ownership. The slum dwellers were not involved in barrel construction and compost sale. Communities will never grow in confidence or in a sense of ownership, unless they have both the financial and

management authority, which may affect the sustainability of the project (Peters 1998).

- **Waste management committees were empowered to oversee the waste collection activities. They were not involved in supervision of the composting activities.**

In the Prism project, the community was more participatory and co-operative. This was made possible by empowering the waste management committees to supervise the activities of the CBOs. The community built up capacity and rights over the project activities. They used to monitor the quality of the service and the CBOs were accountable to them for the service. This developed ownership feelings among the community residents about the project. In the city of Hyderabad, the waste collection project was successful because local level committees were empowered to oversee the performance of the waste collection contractors (Post and Baud 2004).

The waste management committees were formed to monitor the CBOs' waste collection activities. They were not included in the supervision of the composting activities. Composting is a technical as well as a commercial undertaking, which needs a great deal of effort from community mobilisation to product marketing. For this community organisations or committees need to build capacity and structure.

The NGOs were working under donor support committed to demonstrate successful pilot projects. For demonstrating the success of the pilot projects, the NGOs were involved in all stages of the project management from project planning to implementation, where there was limited scope for the community to be involved. The projects had no plan to build capacity of the community organisations or to develop any transferring mechanism to run the projects in future. At this stage of commitment and community participation level, the donor supported community-based composting projects could hardly be sustained.

From the inception, if the project had to designed or planned for future operation and accordingly built capacity of the community organisations or developed a transfer mechanism for the project, it would have been worth continuing the programme after completion of the project. In Bangalore, India CEE (Centre for Environmental Education) composting project in collaboration with UWEP/WASTE sustained its activity by formation of a waste management committee from the community residents. The committee was provided with the responsibility to run the project by

setting fees, holding meetings periodically to review the project activities and financial aspects (Iyer 2001). From the Bangalore example, it can be certain that sustainability of the community-based projects is possible if the waste management committees take responsibility for the project, either to run the project by themselves or by recruiting staff. Appleton et al. (2000) disagreed with the concept of sustainability of community-based projects run by waste management committees who can hardly meet the supplementary costs (uniforms, medicines etc.) after withdrawal of the NGO support. In this case, the committees may need to collect higher charges from the community residents. Salequzzaman et al. (2000) asserted that if the community benefits from the service, then they may agree to support the programme by paying higher charges.

5.5 Community contribution

The previous section 'Community ownership' indicated that if community derives benefit from the project, they will feel responsible and consequently willing to pay for the service. This section discusses 'Community contribution' which may be in the form of money, material and labour. The community can contribute financially by paying fees for the waste management service, by providing collection equipment or by physically working as van operators, fee collectors or as community volunteers for motivating the community members. McCommon et al. (1990) included membership of the committee or participation in the project meetings as a form of community contribution. In this research community contribution refers to payment of fees for the service to ensure financial sustainability of the project and representation on the committees to deal with the actual needs and interests of the community. This research emphasises the community contribution towards composting.

Community-based composting project of Waste Concern

In the Waste Concern project, community contribution was mainly confined to payment of collection fees for the door-to-door waste collection services. The fees were fixed from Tk. 10 to Tk. 20 depending on the ability and willingness of the residents to pay for the service. The participation of the community residents in financial contribution was very encouraging, in Dhalpur area 93 percent, Green Road 92 percent and Mirpur 94 percent, which indicated that community residents realised

the benefits of the service and were satisfied with the quality of service (Table 5.11). People will be more willing to pay for the service if they find it reliable and value for money, or in other words the project is generated from the community demand (UWEP 1996).

Project areas	Total participated households	Collection fees per households/month	Total collection fees collected/month	Total households paying fees	Percentage of households paying fees
Dhalpur	440	Tk.10- Tk.15	Tk.6000	410	93
Green Road	543	Tk.10	Tk. 5000	500	92
Mirpur	910	Tk.10- Tk.20	Tk. 17100	855	94

(Source: From Waste Concern during field survey 2004)

The operation and maintenance expenditures of the composting projects were met from the waste collection fees. It is difficult for the composting projects to run at a cost covering price and it has to meet extra costs out of contributions (Iyer 2001). Three questions were asked of the community residents to know their views about the willingness to pay for composting (questions 23, 24 and 25 of the questionnaire in Appendix B1)

- Will you pay for composting?
- If Yes, why do you want to pay?
- If No, why are you not interested to pay?

Willingness to pay for composting is an important factor. If the community do not have a felt need, it will discourage their participation as well as their willingness to pay. The respondents were divided into Dhalpur Yes (36 percent), No (64 percent), Green Road Yes (40 percent), No (60 percent) and Mirpur Yes (34 percent), No (66 percent) (Table 5.12). The respondents indicated the reasons in favour of payment for composting as: community has responsibility for their waste; proper management of waste has an impact on health and the environment; and a few of the respondents expressed an opinion in favour of helping the poor who work with wastes. The respondents who were not interested to pay for composting disclosed their views that waste disposal and recycling are the responsibility of the municipality and they are paying municipal taxes for the waste management service. Zurbrugg (2002) has the same opinion that many people are paying only for the removal of waste from their

immediate environment and under the present municipal tax system they are not concerned with its ultimate disposal or management.

Table 5.12: Willingness to pay for composting by the community			
Willingness to pay (%)	Reasons behind paying for composting (%)		
	Good for health and environment	Community responsibility	Help the poor
Dhalpur Yes 18 (36.0)	10(20.0)	8(16.0)	
Green road Yes 20(40.0)	11(22.0)	7(14.0)	2(4.0)
Mirpur Yes 17 (34.0)	15(30.0)	2(4.0)	
	Reasons of not paying for composting		
	Municipal responsibility	Paying taxes for waste management	Not community responsibility
Dhalpur No 32 (64.0)	17(34.0)	14(28.0)	1(2.0)
Green road No 30 (60.0)	18(36.0)	11(22.0)	1(2.0)
Mirpur No 33 (66.0)	13(26.0)	17(34.0)	3(6.0)

Management committees are important platforms for the community to monitor and control the performance of the service, administer the project activities and access the decision making process (Anschutz 1996). In Mumbai, India Advanced Locality Movement (ALM) is the forum for community representatives to exchange views with local authorities to resolve the local problems (Zurbrugg et al. 2003a). So representation of the project committees has a great impact on project execution and management.

In Waste Concern's project, a community team 'Green Force' was intended to form at the beginning of the project involving the volunteers specially the housewives, youths and retired persons to monitor the project activities. The existing welfare associations were not happy with the formation of another organisation to work in parallel with them and ultimately Green Force was not activated to supervise the waste related activities.

Barrel composting project in slums

The barrel composting project was owned and operated by the slum dwellers. They made contributions to the project physically by source-separating the wastes and by keeping the waste properly in barrels. The slum dwellers were paying monthly Tk.

200 for electricity and Tk. 20 for water. From the survey it was found that solid waste was not the priority problem for the slum dwellers over other utility services. Only 28 percent of the slum respondents were willing to share the barrel costs. This indicated that the slum dwellers were not motivated to pay the project costs.

Community composting project of Prism

In Prism project, CBOs were collecting wastes from all categories of households from rich to poor income groups. The collection fees were fixed according to income levels and decided by the waste management committees. The households were paying Tk.5 – Tk.15 per month. In Prism projects, fee collection efficiency was 80 percent (Table 5.13). It was encouraging that 40 to 50 slum households were included in the waste collection services paying a nominal collection fee.

Project areas	Total participated households	Collection fees per households	Total collection fees collected/month	Total households paying fees	Percentage of households paying fees
Plant-1 at Boira Ward No. 9,14,15	1400	Tk.10- Tk.15	Tk.20000	1175-1200	85
Plant-2 at Khalishpur Ward No. 10,7,11	1000	Tk.5 (40 -50 family) Tk.10(700-750 family)	Tk. 6000	750-800	80

(Source: From Prism during field survey 2004)

Two committees were working to supervise the waste collection activities of the CBOs. A Waste Management Committee (WMC) was formed in each block consisting of a convenor with 10 to 15 members. The majority of the committee members were school teachers, lawyers and social workers who had acceptability in the community. One third of the committee members were women. A Ward Environment Development Committee (WEDC) was formed in all working wards. Ward commissioners headed the WEDC which comprised a cross-section of social leaders of the society, CBO and NGO representatives and representatives of various private and public service agencies.

Sylhet Partnership Company composting project

In the Sylhet Partnership project, from two pilot wards, 2700 households were paying Tk.15 and 2000 business establishments were paying Tk. 25 for a primary waste collection service. The business establishments were regular payers. Initially, there

was some reluctance from the households to pay charges for the waste collection services and the company provided free services for the initial three months. When people realised the benefits of the service, they agreed to pay. From the data supplied from plant manager it was found (Table 5.14) that the payment efficiency of the waste collection charge was low (around 40 percent from households), but from the business establishments was more than 90 percent.

Project areas	Total participated households	Collection fees per households	Total collection fees collected /month	Total households paying fees	Percentage of households paying fees
Ward No. 1 and 2	Business establishment - 2000	Tk.25	Tk. 40000	1850	93
	Households- 2700	Tk.15	Tk. 16000	1100	41

A waste management steering committee was established to observe and support the implementation of the pilot project. It was comprised of representatives from Sylhet City Corporation, Ward Commissioners, businessmen and local entrepreneurs. The company had an advisory partnership board headed by the Mayor with members from the business community, academia and NGOs. In this project, there was little contribution from the community households and there was no representation from the community on the waste management steering committee.

Key points and discussion

- **There was high participation of the community residents to pay the waste collection fees but reluctance to share the cost of composting.**

In Waste Concern's community-based composting projects, the community residents were regularly paying collection fees and the efficiency was more than 90 percent. The waste collection fee was a voluntary contribution. The waste collection charges can cover about 32 percent of the project cost (Rytz 2000). Community-based composting projects are running short to cover the project cost (Iyer 2001). From the community household survey on willingness to pay for composting, the respondents had low willingness to pay for composting and they argued that waste disposal was the responsibility of the municipality and they were paying municipal taxes. This view was also reflected by Nunan (2000, p-351) '*Many people believe that it is the*

municipality's responsibility to collect waste and do not want to make additional payments'.

- **Existing welfare committees would not be the true representation of the community to look into the waste management problems.**

In Waste Concern's project areas, existing community welfare associations were representing the communities. Green Force, which was intended to be a community watchdog formed at the beginning of the project for monitoring the project activities, was not activated. The welfare committee representatives were not happy to form a new forum. For this reason, no separate committees were formed in the project areas to avoid conflict. It is difficult to say whether the existing welfare associations would have been representative enough to address the actual community interests or to respond the community needs. The welfare associations were comprised of community leaders who were all volunteers with a permanent job and had limited spare time. It was hard for them to put effort and to spare time for project development and monitoring activities. In Chad, a sanitation committee consisted of influential persons who were not in consultation with the community people (Anschutz 1996). In Sri Lanka, community representatives were more loyal to the municipality and unresponsive to community needs and problems (Sirisena 1989).

- **Slum dwellers were not motivated to pay or share the cost of barrels.**

In the barrel composting project, community contribution was in the form of labour. The slum dwellers used to separate wastes and put them in specific barrels. The project was donor supported. All the costs were borne from the project fund. The slum dwellers were not motivated to share the project costs. This was discouraging because the slum dwellers were paying the electricity and water bills but unwilling to share the barrel cost.

- **Since the community had understood the need and importance of proper waste handling, at this motivational level it might be possible to convince community to pay for composting.**

In Prism's project, with very little effort Prism was successful in introducing source-separation. The project activities were monitored by the waste management committees, who used to assist the CBOs in collecting waste collection fees and motivate the non-participating households. The waste management committees had an administrative structure and were empowered to take decisions on waste management

activities. It could be predicted from this institutional arrangement that community support or contribution might be extended to composting.

- **Waste management committees were the representatives of all sections of people and agencies. They might be ideal to supervise the composting activities if they would build the capacity to do so.**

The waste management committees were the true representatives of the community. The committee members were selected from the community residents who had acceptability in the community and could spare time for the project activities. There were women represented on the committees. In the Ward Environmental Development Committee (WEDC), the local ward commissioner was heading the committee and there was involvement of both private and public service providing agencies. This ward committee was the ideal platform to bring together the citizens, public representatives and CBOs/NGOs. WEDCs were formed to take responsibility for waste collection services. There was no scope for the organisations to build capacity or integration into the composting project.

5.6 Summary of the chapter

This chapter has examined the insights into community awareness and participation in community-based composting projects that include:

- Perceptions of the community residents about solid waste recycling and disposal
- Motivation of the community residents towards composting
- Concern and attitudes of the community residents towards compost facility siting in the community
- Financial contribution and willingness to pay for the composting
- Responsiveness and level of participation of the community.

Four indicators were taken to support and explain the role of community awareness and participation for measuring the sustainability and replication of the community-based composting projects:

- community motivation and attitude
- community acceptability
- community ownership and

- community contribution

The research is guided by the hypothesis **‘Community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered’.**

Four cases were taken in three cities of Bangladesh. In these cases primary waste collection was the main activity whereas composting was developed as a secondary or supporting activity to demonstrate waste reduction and recycling of waste.

Some of the key findings of this chapter were:

Community motivation

- Motivation of the community towards composting was low. The motivation and awareness of the community was confined to cleanliness of their own premises, not for waste disposal or composting.
- Slum dwellers were interested in doing barrel composting motivated by health improvement and income generation. They were less interested to invest money in barrel composting due to the possibility of sudden eviction, loss of barrels and the perception that donor/NGO would provide them with a free waste management facility.
- In the Prism project, the CBOs and waste management committees were successful in executing the primary waste collection services but they were not motivated or allowed to build capacity (both institutional and financial) to take responsibility for the composting projects.
- The motivation behind the Sylhet Partnership project was to execute composting in order to make the project self-sustaining.

Community attitude

- In the Waste Concern project, a community attitude survey towards source-separation indicated that the community was less motivated and interested in doing source-separation due to (i) shortage of space in kitchen (ii) needs extra effort and time and (iii) lack of knowledge of what to do and how to separate waste.
- In Prism’s project at Khulna, source-separation of waste was successful in three residential areas because separate containers were provided to

households and waste collection schedules for organic and inorganic were fixed on different dates.

- In the barrel composting project in the slums, economic incentives had influenced the behaviour of the slum-dwellers to do source-separation.

Community acceptability

- From a community survey in Waste Concern's projects, it was learnt that community residents were supporting the waste collection and composting projects as good for the community environment because they could see fewer wastes on the streets and no overflowing dustbins. Some respondents indicated bad smell, breeding grounds for vermin and local hazard or nuisance as negative impacts of composting in the community.
- From the point of view of statistical significance it was found that the closer the composting facility was to the community, the more odour or nuisance complaint would likely to receive was not always the case; particularly, if the community was involved in site selection or aware of the process and its impact.
- Low level of involvement of the community in project planning and implementation or lack of information sharing with communities may discourage composting activity in the community.
- Selection of sites with consensus views of the users and financial incentives could overcome the inconvenience of the barrel composting, such as leaching from barrels, odour, space constraints etc.
- In the Sylhet Partnership Company composting project, the wastes were being treated without disclosing the actual information to the nearby residents. This may affect the credibility and acceptance of the composting project.

Community ownership

- In the community-based composting projects of Waste Concern, community involvement was confined to the mobilisation and awareness building stage which was the lowest level of the Arnstein's ladder of community participation. This level of participation was not effective in developing a sense of ownership and responsibility.

- Low level of willingness to pay for the composting operation and use compost in gardens by the community residents indicated the community's low level of responsiveness or sense of belonging to the project.
- In the barrel composting project, a participatory process was adopted during the selection of barrel locations, which was effective for creating community ownership and obtaining consensus views of the slum dwellers. In the implementation phase, slum dwellers were not involved in barrel construction or compost sale. Unless the slum dwellers obtained both financial and management authority, they would not feel responsible for the project or grow any sense of ownership.
- In the Prism project, the community was more participatory and co-operative. This was possible through empowering the waste management committees to supervise the activities of the CBOs. The activities of the CBOs or the waste management committees were confined to primary waste collection and not extended to composting.

Community contribution

- In the Waste Concern project, the community residents were very regular in paying collection charges which indicated that community residents realised the benefits of the waste collection services. But they were less committed to paying for the composting operation. Some of the respondents argued that waste disposal and recycling was the responsibility of the municipality and they were paying municipal tax for the waste management service.
- In the project areas, existing community welfare associations were representing the communities. Green Force which was intended to form during the project intervention was not activated from the beginning. The welfare associations were not happy to form another organisation for the waste management activities. The community leaders had permanent jobs and limited spare time. It is difficult to ascertain whether the existing welfare associations were representative enough to deliver the actual demands and needs of the community residents.
- In the barrel composting project, the slum dwellers were not motivated or interested to pay for the barrel composting, but they were paying water and electricity bills regularly. They perceived the idea that donors would pay for

the waste management facility. The donor dependency was discouraging for the project continuation.

- In Prism's project, CBOs and waste management committees were very active. The community residents were co-operative. In three residential areas, Prism was successful in introducing source-separation with little effort. The CBOs and the waste management committees would be able or ideal to supervise the composting activities if they could build capacity to do so.
- The waste management committees were the true representatives of all cross-sections of people. The committee members were selected from the community residents who had acceptability in the community and who could spare time for the project. The Ward Environmental Development Committees (WEDCs) were formed to take over the responsibilities for the waste collection services in future. These committees were not allowed to build capacities or involved to monitor the composting activities.

Until recently, in the planning and implementation of the community-based composting projects, there was little participation of the local community. The community participation was confined to primary waste collection. The community was not motivated enough to take the responsibility or to pay for the composting activities. The low level of willingness to pay for composting indicated that the residents were more motivated for the cleanliness of their immediate environment, rather than for the ultimate disposal of their wastes.

The NGOs were working under donor support committed to demonstrate successful pilot projects. For demonstrating the success of the pilot projects, the NGOs were involved in all stages of the project management from project planning to implementation, where there was limited scope for the community to be involved. The projects had no plan to build capacity of the community organisations or to develop any transferring mechanism to run the projects in future. From the point of view of sustainability such projects might have the chance to disappear after the donor support ended.

Chapter 6

Local Government perceptions and attitudes

6.1 Introduction

The previous chapter discussed the community awareness and participation. It was found that involvement of the community in consultation, planning, implementation and project monitoring is vital and can ensure sustainability, since it empowers the local community, encourages them to contribute inputs and gives them a sense of responsibility and commitment. This chapter discusses local government perceptions and attitudes towards community-based composting. According to the Oxford English Dictionary 'perception' means observation and views, and 'attitude' means manner and approach. In this research context 'perception' refers to awareness, feelings and level of satisfaction of the municipal officials about the community-based initiatives and 'attitude' refers to expression of thoughts and support towards community-based initiatives in the prevailing political environment and policy framework of the local government institutions.

Local government municipalities are the service providers. They are empowered from the central government with an allocation of budget and statutory right to serve the citizens. In this study local government participation will be looked upon not as a service provider but as a facilitator of the community-based projects. The specific research question explains municipal co-operation and facilitation by:

'What awareness and attitudes do local government officials have towards waste reduction and composting?'

What legal and political environment exists in the local government authorities and how does this impact on the sustainability and replication of community based composting projects?'

Municipal officials' awareness and attitudes, political will, policy and legislation are taken as the indicator parameters to probe the thesis (Fig 6.1).

Three main data sources are used to analyse the local government aspect. These include:

- Group discussion with the conservancy officials

- Interviews with municipal decision-making officials and municipal commissioners (elected representatives of the wards)
- Review of policy documents along with personal observations and experiences of the author.

Views of municipal officials of three city corporations Dhaka, Khulna and Sylhet were taken because the composting projects were located in those cities.

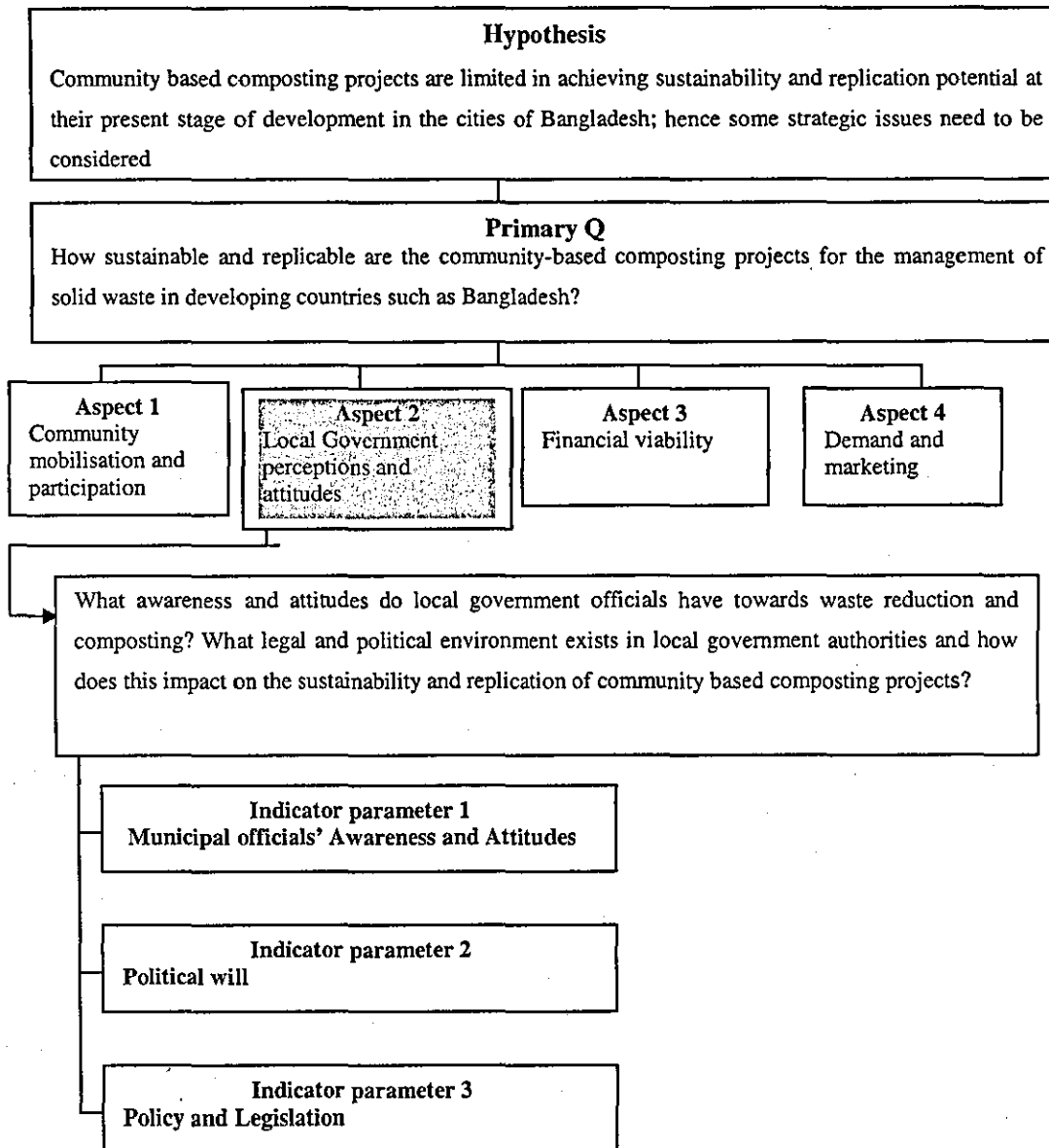


Fig 6.1: Research questions, indicators for local government perceptions and attitudes

6.2 Municipal officials' awareness and attitudes

This section describes awareness and attitudes of municipal conservancy officers about solid waste management and recycling. Conservancy officers are directly responsible for day-to-day solid waste management in their designated areas. They may have possibilities of interacting with the CBOs and NGOs engaged in community-based waste collection activities. Their views and opinions may reflect the actual motivation and attitude of the municipality and may have significant implications in the thesis.

In this research 'awareness' refers to knowledge of municipal conservancy officers about community-based waste collection and composting activities and 'attitude' of municipal officials measures their support towards the community-based initiatives and their willingness to incorporate them in the mainstream of formal solid waste management.

The municipal awareness and attitudes were observed and measured through the outcomes of the group discussions with the conservancy officers of two zones of Dhaka City Corporation (Section 3.7.4 of the methodology). The group discussions with the conservancy officers reflected their views and attitudes towards community-based waste collection and composting activities. In the municipal administrative system, Chief Executive Officer and Chief Conservancy Officer of the city corporations are the decision making authorities of waste management. Their views and opinions were recorded by semi-structured interviews.

In Dhaka, from the group discussions with municipal conservancy officers, it was found that conservancy officers had positive feelings for the CBO/NGO-operated community-based solid waste collection services. They acknowledged the benefits of the community-based waste collection service as it had improved the waste situation of the community. Despite the benefits, conservancy officers pointed out some negative observations in the community waste collection initiatives. The workers of the initiatives were not keeping waste properly inside the secondary containers which created a messy scenario around the containers and ultimately undermined the municipal image. The conservancy officers were asking for co-operation from the community-based waste collection initiatives for efficient transfer of waste from the secondary points.

At the other end of the scale, municipal conservancy officers had very little conception about the potential benefit of composting as a waste reduction and recycling strategy for solid waste management. Their knowledge about waste recycling was mostly confined to paper, cloth, and glass scavenging and recycling by waste pickers and informal waste traders. In Zone²⁶-1, only one out of ten conservancy officers had any idea about the composting plant at Dhalpur. The conservancy inspector of Dhalpur area came to know about the project when he was remonstrating with a compost worker for keeping waste outside the container.

However, in Zone-8 at Mirpur, six out of eight conservancy officers got the idea of composting from a training programme arranged by Waste Concern a few years ago. They visited the Mirpur compost plant as part of the training programme. In Mirpur, the awareness of the municipal conservancy officers was high and the attitude of the conservancy officers towards the community-based composting projects was very positive. Some of the benefits reported by the conservancy officers in the group discussion were:

- The area was cleaner and the residents gained enough awareness and stopped littering in the streets.
- It had reduced the number of dustbins in the community.
- The municipal conservancy officials were getting fewer complaints from the public.
- It had reduced their workload and
- As a whole it had increased the image of City Corporation.

In Dhalpur, the conservancy officers had different views and opinions. They had no confidence in pilot projects. They observed that a pilot biogas plant constructed by Bangladesh Council for Scientific Industrial Research (BCSIR) in 1993 was not operational after its inauguration. Striking this experience they felt that although a pilot project might show good results, it may not have any lasting effect. On this understanding, they opined that community-based composting might be a wrong approach for waste management.

From the interviews with the Chief Executive Officer and Chief Conservancy officer of Dhaka City Corporation (DCC), it was learnt that:

²⁶ Zone- the decentralised administrative area of public services consisting of a number of wards.

- Open dumping was the prevailing practice of waste disposal in DCC.
- DCC had no strategic plan to incorporate small-scale waste reduction and recycling project.
- Small-scale composting project did not gain attention of the city authority as an effective solid waste management technique (Box 6.1 and Box 6.2).

Box 6.1: Interview with Chief Executive Officer of Dhaka City Corporation

Chief Executive Officer, Md. Habibur Rahman of Dhaka City Corporation (DCC) in his interview mentioned that DCC was disposing waste by open dumping and it was facing problems with the landfill spaces and the increased disposal costs. They felt the need for reduction of their wastes and its subsequent management cost. He got the idea about waste reduction and recycling by composting from Waste Concern's presentations in different seminars and meetings. According to his observation, small-scale community-based composting project sounded good for the solution of solid waste management problem. But the magnitude of the project operation was so small that it was difficult to think that they could be able to give solution of their waste management problem. (Source: Excerpt from interview transcript 2004)

Box 6.2: Interview with Chief Conservancy Officer of Dhaka City Corporation

Chief Conservancy Officer, Md. Sohel Faruqui in an interview said that small-scale community composting project was encouraging but in a mega-city with thousands ton of wastes, it could not be able to make a significant impact on the overall solid waste management in the city. It would be wise to think of scaling the projects on a city- scale for its entire solution. (Source: Excerpt from interview transcript 2004)

In Khulna, conservancy officers of Khulna City Corporation (KCC) appreciated the CBOs and NGOs activities in Khulna city for keeping the city clean. There was a good linkage between the CBOs/NGOs and KCC. To make the community-based initiatives more effective KCC took some initiatives:

- Gave authorisation by signing Memorandum of Understanding (MoU)
- City mayor formally inaugurated some of the city cleanliness programmes and participated in the rally.
- Extended support (moral and logistic) by the conservancy department.

In a group discussion, the KCC conservancy officers expressed their satisfaction with the positive initiatives taken by the NGO Prism:

- Brought the whole city in an uniform waste collection service
- Co-ordinated with KCC in waste handling in the secondary waste collection points

- Formed waste management committees to watch over the local solid waste problems
- Provided training to the KCC officials for capacity building in waste management.

The systematic works of Prism for addressing the solid waste problems relieved KCC from public complaints and thus developed their confidence in Prism's activities. Prism used to maintain a close link with KCC for the improvement of the solid waste situation in the city. When Prism started composting as part of their waste reduction programme, KCC provided a piece of land. The chief conservancy officer of KCC in an interview showed a positive attitude and willingness to support the composting service. According to his observation composting could improve the waste situation of the city and thus reduce the waste transportation and disposal cost.

In Sylhet, Sylhet City Corporation signed an economic accord with the London Borough of Tower Hamlets, UK in a twin city co-operation programme under the European Union Asia-Urbs project. The municipal conservancy officers were satisfied with the Sylhet Partnership activities as long as it was under European Union support. It provided capacity building and expatriate consultative support to Sylhet City Corporation (SCC) on waste management. It brought mobilisation into the SCC activities and created awareness and behavioural changes in the community. When the fund ended, Sylhet Partnership started working with its local personnel. The local human resources of Sylhet Partnership were not sufficient to provide technical assistance or capacity building support to SCC; rather it was working as a parallel organisation (Box 6.3).

Box 6.3: Interview with Chief Executive Officer of Sylhet City Corporation

According to Chief Executive Officer of SCC, Sylhet Partnership (SP) was formed and a formal agreement was signed between SCC and SP to build up an institutional linkage between these two organisations. After the initial phase, SP was in financial hardship. It replaced the expatriate executive with the local one and became involved on its own in primary waste collection and composting activities.

(Source: Field visit 2003).

Key points

- Municipal conservancy officers were supporting the community-based waste collection initiatives because indiscriminate dumping of waste in the

community had been reduced. However, they felt the need for co-operation from the community initiatives for keeping waste properly in the secondary containers.

- In Mirpur (zone -8), the attitude of the municipal conservancy officers was in favour of the community-based composting project because most of the officers had gathered knowledge from the training and visit programme of Waste Concern in Mirpur composting plant.
- DCC conservancy officers of Dhapur (zone-1) were not aware of the composting activities and they perceived the idea that the pilot project might show a good result but would not have lasting effect.
- Municipal high ranking officers perceived the idea that a small-scale composting project would not have any significant impact on waste reduction and therefore would not contribute to a reduction in waste transportation or disposal cost.
- In Khulna, NGO Prism was maintaining a good linkage with KCC. KCC conservancy officers were satisfied and had confidence in Prism's activities. They supported Prism's waste reduction strategy and provided a piece of land for the composting project.
- In Sylhet, the conservancy officers thought that the capacity of Sylhet Partnership with the local personnel was not enough to support SCC in waste management rather it seemed to be working as a parallel organisation to SCC.

Discussion

Municipal officers lacked knowledge and skills in waste reduction and recycling. There was no institutional arrangement in the local government to train the municipal officers to build knowledge and capacity in waste management. The prevailing bureaucratic system in the local government discouraged the municipal officers from working with the community initiatives. The conservancy officers who had received training from Waste Concern gained enthusiasm and positive attitude towards the composting project. But in the other project, in which Waste Concern did not provide orientation to the conservancy officers about the composting activity, officers thought that composting would not bring an effective solution to their waste management problems. In Malaysia, local authorities did not have sufficient knowledge and skill

related to recycling, so the success of door-to-door recyclable purchasing project was far below the expectation (Noor 1997). In African cities one of the problems faced by the community-based composting projects was the negative attitude of waste management officials who felt that community-based composting was the wrong approach to addressing the waste problem (Asomani-Boateng and Haight 1999). The decision makers of DCC perceived the idea that a small-scale composting project would not have any significant impact on the large quantities of city wastes or contribute to the reduction in waste transportation and disposal cost. The Local government authority lacked motivation to put efforts into small-scale recycling projects and lacked interest in providing lands for recycling (Yousuf 2000). Plummer (2000) pointed out that a majority of the local governments are dominated by engineering-led, capital intensive works and technical professionals who find the concept of community participation and small-scale intervention irrelevant to development activities. Adopting this institutional culture and top down approach, the local government authority perceives community/NGO led activity as a threat to formal activity (Sohail et al. 2001; Gupta 2003).

In Khulna, the NGO Prism established a good link with the local government authority, which helped them to get land for composting. In Dhaka, the city authority did not give importance to composting as a waste reduction strategy and the administrative formalities for the allocation of a piece of land for composting took two years. Post and Baud (2004) commented that proving land free of charge is simply a political gesture rather than an attempt to reduce municipal waste flows.

In Sylhet, the Sylhet Partnership Company was working in the waste collection and composting activity as a parallel agency which functioned virtually independently without much co-operation with the municipality. Dulac (2001) reiterated the importance of government support for an effective and sustainable community-based initiative.

From the discussion, it can be concluded that low level of municipal support and lack of acceptance of the community-based composting projects are due to lack of knowledge of the municipal officials about the potential benefits of composting. Knowledge or know-how about composting is confined to the NGOs/manufacturers, who do not share their ideas widely or disseminate the knowledge to the municipal authority (Zurbrugg et al. 2003b). The composting projects are largely dependent on

municipal support and co-operation for land allocation and collection of rejects. They may obtain land and other logistical support from the municipal authority as a subsidy against landfill savings. The municipal authority needs to be motivated and be convinced of the importance and economic benefits of composting. It depends on political will of the local government. In Hyderabad, success of the Voluntary Garbage Disposal System (VGDS) was achieved because the Municipal Corporation of Hyderabad supported the programme both politically and financially (Post and Baud 2004).

6.3 Political will

The previous section discussed local government awareness and attitudes. It was found from the section that low level of municipal support and acceptance for the community-based composting projects was due to lack of knowledge and awareness of the municipal officials about the potential benefits of composting. If the municipal officials were provided with knowledge, they would gain more enthusiasm and willingness to support the community-based activities. In addition, lack of organisational development, rigid bureaucracies, authoritarian and political cultures discourage or restrict municipal officials from working with communities and NGOs (Plummer 2000; Sohail et al. 2001). This section discusses the political will of the local government with regard to support the sustainability and replication of community-based composting projects. Political will in this research context refers to political decisions of the local authorities to extent their support towards community-based composting projects and to give them recognition. Local government municipalities are the political institutions, where the development activities are patronised through political interest and priority. Therefore, recognition of the community-based solid waste management initiatives is important because it may provide them with legitimacy to collect fees from the community and relieve them from political interference.

Local government municipalities can assist community-based solid waste management projects by providing facilities (start-up fund, collection equipment, composting site) or by formulating policy or strategy conducive to organic waste recycling. On the other hand, the local government municipalities can discourage

community-based solid waste services directly or indirectly by refusing to provide them with support or official recognition.

Interviews with ward commissioners (the elected representatives) and Chief Executive Officers were conducted to observe the political priority, interference and concern for solid waste management and recycling.

The political structure of Dhaka City Corporation was headed by a Mayor, 90 ward commissioners and 30 women commissioners who are all elected for 5 years. The organisational support for solid waste management comes from the conservancy department which is headed by a Chief Conservancy Officer. Solid waste collection, transportation and disposal are the statutory responsibility of the conservancy department. The unreliable and inefficient waste collection service of DCC compelled the community to organise their waste collection activities in Dhaka city. In most parts of Dhaka city, CBOs/NGOs were providing waste collection services from houses to dustbins through door-to-door van services. Due to the lack of planning and co-ordination between community-based waste collection initiatives and DCC, wastes were found scattered on city streets. This gloomy environment drew the attention of the highest authority (Prime minister's office). The Chief Executive Officer of DCC, in his interview, said that after getting instruction from the highest authority of the state for keeping the city streets clean; DCC took some positive political decisions for solid waste management:

- Arranged meeting with the CBOs/NGOs who were engaged in primary waste collection and recycling activities
- Introduced a system of permission to CBOs/NGOs for streamlining and co-ordinating their activities
- Privatised waste collection and disposal services in two zones
- Invited Expressions of Interest for waste reduction and treatment on BOOT (Build-Operate-Own-Transfer) basis.

Solid waste management is a poorly resourced activity spending only 10 to 15 percent of the development budget. The prevailing practice of waste disposal in Dhaka city was the open dumping. There were no formal waste reduction and recycling activities for waste disposal. The Chief Executive officer of Dhaka City Corporation said that due to limitations in financial and management capacity, DCC was disposing waste by open dumping. He acknowledged the importance of waste reduction as DCC was

running short of landfill space. To overcome the crisis of waste management, DCC invited bids for large-scale investment. He further added in his interview that small-scale community-based composting projects were better for community mobilisation and participation but they did not have a significant impact on the large volume of wastes. The interview indicated that the institutional culture of the local government was in support of big investment projects which could undermine the potential application of community-based waste recycling and composting initiatives.

Ward commissioners are the elected representatives and key in local level activities. Local politician interference in community-based initiatives is very common in the developing countries (Rabinovitch 1992). Ward commissioners always want a supervisory role in ward level activities and try to bring them under their control. ADBI (1998) disclosed that local authorities of Asian cities found political interference as an obstacle to development projects, as the elected representatives did not confine themselves to the strategic policy and planning process but were more interested to become directly involved in the development projects. The interviews with the ward commissioners clearly indicated their political motivation and interest towards community-based waste management activities:

- In Mirpur, the ward commissioner was progressive and recommended Waste Concern's community-based composting project as a good approach towards local level waste solution.
- In Green Road, the ward commissioner had a negative attitude towards the community-based waste management initiatives as it seemed to him as a nuisance in the community. He laid emphasis on institutionalising and integrating the CBOs/NGOs activities under DCC's control and accountability.
- In Dhalpur, the newly elected ward commissioner (ward no. 85) stopped the activity of Waste Concern, when he heard that the wastes from other areas (ward no. 30) were being processed in the composting plant. The project resumed its activity when Waste Concern acquainted the ward commissioner about the project activity and kept his supervisory role on the project activity.
- Ward commissioner of ward no. 30 co-operated with Waste Concern's primary waste collection service in his ward. At the beginning, the female ward commissioner obstructed the waste collection activity of Waste Concern

as she wanted to engage her political followers/activists in the service. But the male ward commissioner took this as a challenge and opposed the intervention of the female ward commissioner.

In Khulna, waste management committees were headed by ward commissioners. They were well acquainted with the community initiatives and they had control over the project. Prism organised meetings with the ward commissioners and sought their suggestion and co-operation for the improvement of the waste management services. In an interview one ward commissioner (ward no.14) said that he was satisfied with the primary waste collection service in his ward. However, he was not interested in including composting activity at the ward level and indicated that waste reduction or recycling were not priority issues for a local politician.

In Sylhet, the municipality had recently been upgraded to City Corporation. The mayor and ward commissioners were newly elected. Sylhet City Corporation (SCC) was open to ideas from the public and NGOs and it had the scope to incorporate innovative waste management ideas into its political decisions.

Key points

- In the present political motivation, solid waste management has been given low priority and provided more limited funds than the other municipal services in developing countries.
- The improvement in the conventional approach of solid waste management might be activated through the political decision and priority of the highest authority.
- Local government authority encourages large investment and prefers to establish links with large enterprises, while small-scale initiatives get less priority in solid waste management.
- The prevailing political decision in local government authorities is towards open dumping which is a cheap means of waste disposal. Local authority has little understanding and motivation towards the potential savings from waste reduction by small-scale composting.
- Local government municipalities are the political institutions where the development activities are patronised through political interest and priority.

- Ward commissioners are the key to local level activities. Without their co-operation and support, no organisation can perform activities smoothly.
- Ward commissioners prefer to take control over the CBOs/NGOs activity and try to make the initiatives accountable to them.
- A political change, conflict or different political affiliation may restrain the development of the community-based activity.
- Progressive role of the politicians is a success factor for the community-based solid waste management.

Discussion

In Dhaka city, the CBOs/NGOs activities in primary waste collection started due to the unreliable and inefficient service of DCC. In the bureaucratic and centralised administration system in the local authority, there were no formal community development programmes or involvement of city dwellers in the planning and implementation process. The lack of recognition and bureaucratic attitude of the senior officials could restrain the development of community-based composting initiatives.

In Khulna city, there was a good co-ordination between KCC and NGOs/CBOs. KCC recognised and authorised the activities of the community initiatives and a marked improvement was observed in waste management. This happened due to the political will and progressive political decisions of KCC. In Ecuador, Quito municipality authorised and supported the neighbourhood sorting and composting project by selling recyclables and collecting rejects (Anschutz 1996). In India, Bangalore City Corporation provided land and official recognition for the waste collection and composting activities of the NGO Centre for Environmental Education (Iyer 2001). However, in Lucknow, India a local NGO 'Muskan Joyti Saniti (MJS) got support (land, capital and equipment) from the state government but Lucknow Municipal Corporation did not provide any co-operation and regarded any success as a threat (WSP-World Bank 1999). The SIDRO project in Mexico faced a problem in securing government support because the government feared that in CBO activities for empowering the poor people might undermine its political image (Klundert and Lardinois 1995).

The prevailing financial and institutional capacities as well as the political culture in DCC were not in a position to support small-scale composting as a waste reduction strategy. Open dumping was still considered as a waste disposal option because it was an easy and cheap method of waste management. This view of local government authority was also supported by Post and Baud (2004) who considered that city authorities have not yet developed the outlook or level of commitment and understanding towards the potential savings on waste collection and disposal from composting.

The political decision of DCC favoured a big investment project for waste reduction and recycling as the preferred solution to their wastes. Ali (1997) commented in his thesis that big investment projects are more appealing to politicians than projects of local level small-scale solution. Plummer (2000) pointed out that the political decisions are directed towards the large investment projects. She further added that local governments are dominated by administrators and politicians who lack long term vision and prefer capital intensive implementation in their short tenure. From the discussion, it can be concluded that political will and political culture in local government may influence the sustainability and replication of a community-based solid waste management project.

Ward commissioners are the key in local level waste management. Their co-operation and support is essential for the community initiatives. In Dhaka, it was found that one women ward commissioner was trying to patronise her political affiliate to organise and carry out door-to-door waste collection service and obstructed the waste collection activities of Waste Concern. Another ward commissioner stopped the composting operation as the wastes from another ward were being treated in his ward. Ward commissioners always want more supervisory roles and try to make the CBOs/NGOs accountable to them (Ahmed 2004). In Khulna, this was solved by making ward commissioners the heads of the waste management committees. The progressive commissioner at Mirpur, Dhaka was favourable towards community waste collection and composting activities. In Sao Paulo and Curitiba, Brazil the mayors were very positive towards improving living conditions and waste management services in their neighbourhoods (Klundert and Lardinois 1995). The political power and influence of the ward commissioner is vital for the continuation of

the community-based initiatives. This would be ensured by keeping their supervisory role in the community level waste management activities.

6.4 Policy and legislation

The previous section discussed the political environment in local government which indicated that the prevailing political environment and decisions were not favourable to small-scale community-based waste management and recycling activities. This section discusses policies and legislation of the government related to waste reduction and recycling. Waste management policy, legislation and regulations are the primary means by which governments seek control and influence over waste management practice. Local government municipalities are generally responsible for the provision of solid waste collection and disposal services. They are mandated for the service by the national government, with necessary authority, power and support. The Local government authority endorses solid waste management as part of the sanitation programme from the public health point of view and puts the waste management activity under the conservancy service.

In Dhaka, the conservancy service²⁷ began in the early days of the Moghul regime in 1717. Until the 1960s, there was no law and act administering the conservancy service or waste management. The only act which prevailed was the 'Town Improvement Act 1963' which did not address the waste management and disposal issues. After wards, the introduction of a significant improvement took place when waste management was endorsed in 'Dhaka City Corporation Ordinance 1983'. According to the ordinance (Article 78) Dhaka City Corporation was empowered to regulate the collection and disposal of solid waste from residential, commercial and industrial establishments, and public places. For the services, the municipality could impose a conservancy tax on all units equivalent to 2% of the assessed value of the taxable

²⁷ The conservancy service in Moghul regime was limited to night soil collection. It was managed by manual labourers (mathors which literally means night soil collectors) who used to collect human excreta and dump it in trenched grounds. During the British rule, a municipal committee was formed to look after the sanitation of the city. In 1864 Dhaka municipality was established but the conservancy service was not improved in line with the other city services. In 1963, a separate waste collection service started for refuse collection by cleaners who loaded garbage on bullock carts and disposed of it in nearby low lying areas (Haider 1966).

property which had no direct relation to the quantity of waste generated per person per household. However, the ordinance obliged residents to bring their wastes to secondary collection points from where the corporation made arrangements for transportation and disposal of wastes (Box 6.4). Dhaka City Corporation Ordinance 1983 did not specifically mention the waste reduction and recycling issues. There were no specific rules and regulations to promote recycling activities as well as recycling business. The amended (1989) City Corporation Ordinance [Chapter XIII(140)] stipulated the promotion of community development projects as *'The corporation may, in the prescribed manner sponsor or promote community development projects for the city or any part thereof and may on this behalf perform such functions as may be prescribed.* This section of the ordinance is incomplete and does not tend to facilitate the promotion of community-based activities. This does not clearly indicate the public-community role-sharing issue or public-private partnership exercise.

Box 6.4: Removal, collection and disposal of refuse

1. *The Corporation shall make adequate arrangements for the removal of refuse from all public streets, public latrines, urinals, drains, and all buildings and land vested in the corporation and for the collection and proper disposal of such refuse.*
2. *The occupiers of all other buildings and lands within the corporation shall be responsible for the removal of refuse from such buildings and land subject to the general control and supervision of the corporation.*
3. *The corporation may cause public dustbins or other suitable receptacles to be provided at suitable places and where such dustbins or receptacles are provided the corporation may, by public notice, require that all refuse accumulating in any premises or land shall be deposited by the owner or occupier of such premises in such dustbins or receptacles.*
4. *All refuse removed and collected and by the staff of the corporation or under their control and supervision and all refuse deposited in the dustbins and other receptacles provided by the Corporation shall be the property of the Corporation.*

Source: Dhaka City Corporation Ordinance 1983(Article 78)

The next legal foundation was the 'Environmental policy 1992' which instructed the local government municipalities to restrict disposal of wastes in rivers, ponds and drains, and discourage open truck transportation and day time collection by adopting proper legislation and enforcement. The policy also recommended that the Ministry of Agriculture should promote organic fertiliser and restrict the use of chemical fertiliser.

The Environmental Conservation Act 1995 sections 20(2)(c) and 20(2)(e) emphasised the control and disposal of hazardous wastes and set standards for effluent and discharge into the water bodies. The Environmental Conservation Rules 1997 set out waste disposal and emission standards and kept provision of environmental clearance for the treatment processes. The Bangladesh Environmental Conservation Act 1995 and Rules 1997 stipulated environmental issues. However, there was no regulatory framework in the form of by-laws or regulations concerning solid waste management or recycling activities.

The National Water Supply and Sanitation Policy 1998 encouraged co-operation and co-ordination between government and NGOs, business organisations, private organisations, and laid emphasis on community participation. This policy supports the economic value of wastes as recoverable resources through private and community initiated projects. The main statements related to solid waste management in the National Policy for Water Supply and Sanitation 1998 of Local Government Authority were (Box 6.5) in which one clause was in support of waste recycling.

Box 6.5 Statements related to Solid Waste management

- *Solid waste management has to be self-sufficient and self-sustaining (Clause 8.4.1).*
- *Municipalities may transfer the responsibility of collection, removal and management of solid waste to the private sector (Clause 8.4.2).*
- *Municipalities are empowered to set tariffs and formulate by-laws (Clause 8.4.3).*
- *The participations of private sector and NGO in solid waste management are encouraged by the government (Clause 8.4.6).*
- *Appropriate measures have to be taken to achieve the highest waste recycling rates possible. The organic waste treatment methods like composting and bio-gas production need to be promoted and contamination of ground water by waste materials are discouraged (Clause 8.4.10).*

Source: National Policy for Water supply and Sanitation 1998 (Local Government Division, Ministry of Local Government)

It can be concluded that environmental laws and policies in Bangladesh related to solid waste management were inadequate for the promotion and implementation of community waste collection and recycling activities.

Key points

- City Corporation ordinances on solid waste management put emphasis on collection and disposal, where waste reduction by recycling and reuse were not stipulated.
- City Corporation ordinances were inadequate and ineffective for promoting community development activities.
- There was no active policy and incentive structure (both economic incentive and non-economic motivation) to encourage waste recycling and composting.

Discussion

In government policies solid waste management is still considered as part of the sanitation activity and its functions are carried out as the conservancy service. This service is neglected, poorly resourced and does not have the importance of the other civic services. Local government municipalities have lack of capacity, legal framework and legal limitations in promoting community sponsored or participatory projects. The community-based waste collection and composting projects initiated or implemented by the NGO/CBO initiatives were not generated from the demand of the government policy. These projects were taken solely from an economic and local environmental improvement perspective. According to Post and Baud (2004) local authorities are firmly rooted in the public health perspective by the laws of solid waste management. In the legislation or policy, the emphasis is always on collection and disposal, while the potentials for reducing waste flows by recycling and reuse are hardly recognised. These laws and regulations are not in favour of promoting the community development activities.

The success of community-based composting projects in some cities of Asia is due to policy formulation and decision of the government to give composting a priority over landfill. The Municipal Solid Waste (Management and Handling) Rules 2000 for larger cities of India mandate composting as a way to reduce waste from dumpsites and for environmental improvement. This is an excellent guideline and policy support for the promotion of organic waste management in India which includes:

- Promotion of composting as one of the treatment options for bio-degradable wastes.

- Aims for waste segregation at source for waste reduction and clean recyclables.
- Defined standards for composting sites and compost product.

The Indian waste legislation has encouraged entrepreneurs to do composting business. A large number of composting operations, from small-scale community initiatives to medium-scale composting enterprises, started composting at different scales, types and organisational structure (Zurbrugg et al. 2003a).

The Ecological Waste Management Act of Philippines (2001) emphasised public awareness and a community-based approach as a solution to the solid waste problem, concentrating on waste reduction, resource conservation, recovery and in particular composting activities.

6.5 Summary of the chapter

This chapter discussed the awareness and attitudes of the local government officials, prevailing political environment and policy framework to assess the sustainability and replication of community-based waste collection and composting projects. The research was guided by the specific research question:

What awareness and attitudes do local government officials have towards waste reduction and recycling? What legal and political environment exists in local government authorities and how does this impact on the sustainability and replication of community based composting projects? to probe the hypothesis 'Community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered'. This was analysed by the supporting data gathered from group discussion with the conservancy officials, interviews with decision-making officials of the local government municipality and elected municipal commissioners, and review of policy documents.

From the views of the municipal officers, it was observed that municipal conservancy officers were working in a traditional and bureaucratic waste management system; they lacked knowledge and skills on waste reduction and recycling. The bureaucratic and political environment in the local authorities did not allow them to work with the community initiatives. The conservancy officers who received training had

enthusiasm and a positive attitude towards community-based waste collection and composting activities.

The decision makers of the municipal authority perceived the idea that small-scale composting projects could not have any significant impact on city waste management. The Local government authority preferred a big investment project for a big solution to their waste problem. They considered small-scale intervention irrelevant to their development agenda. The political decision of local government authority was towards open dumping as this is a cheap method of waste disposal. They had little understanding and motivation towards the potential savings of waste reduction from composting.

Ward commissioners are the key in local level waste management activities. They prefer to have the supervisory control over the CBOs/NGOs activities. Ward commissioners were active in organising and supervising primary waste collection services in their wards while waste reduction or recycling were not their priority concerns.

The policies and regulations on solid waste management emphasised collection and disposal of waste, where waste reduction by recycling or composting was absent. The ordinances were inadequate and ineffective for promoting community development activities.

From the discussion in this chapter, it can be concluded that the awareness and attitudes, political culture and policy of local authorities is not supportive of community-based activities at the present stage. From the present political outlook and institutional culture in the local government authority, it would be difficult for the community composting projects to get support and to be sustained. To attain the long lasting effect of the composting projects and its replication, some developments in the local government attitudes or motivation are needed which could be achieved through capacity building measures of the local government officials and the political representatives, and some modification in the policy and legislation.

Chapter 7

Financial viability of composting project

7.1 Introduction

The previous two chapters discussed community participation (chapter 5) and local government perception and attitudes (chapter 6) to measure sustainability and replication of community-based composting projects. It was observed from the community-based composting projects that community participation was limited to primary waste collection service. The local government motivation and attitudes were not supportive of community-based initiatives. Composting projects can contribute towards savings in waste transportation and disposal costs for the local authorities but they have not yet received political approval from the local authorities.

This chapter discusses financial viability with regard to capital and operational costs, revenue and cost savings, and commercial viability in order to ascertain the sustainability and replicability of the composting projects at their present state of development (Fig 7.1). According to EPA (1997), financial viability is defined by the assessment that *'a project will have sufficient funds to meet all its financial obligations whether these funds come from user charges or external sources; will provide sufficient incentive to maintain the project activities; and will be able to respond to adverse changes in financial conditions'*. Financial viability in this research context refers to the continuity of the project on the assurance that revenue earned will balance the cost incurred. This chapter examines the financial viability guided by the specific research question **'Is the financial status and commercial value of the community-based composting project favourable to sustainability and replicability?'**

To study the financial situation of community-based composting, the financial data of Waste Concern projects in Dhaka were detailed evaluated and computed. The financial data of other cases, the composting project of Prism in Khulna and Sylhet Partnership in Sylhet, were evaluated and presented for comparison. Three indicator parameters were selected to examine the financial viability of the community-based composting projects:

- Capital and operational cost – Capital costs were the initial investment costs of the project and the operational costs were the expenses of the composting activities, mainly the salaries of the labourers. This indicator was used to make a comparison between the cost of waste management and the cost of composting to get an idea as to whether composting is financially more attractive than landfill disposal.
- Revenue and cost savings - Sources of revenue from the composting project were the sales of compost, sales of recyclables and waste collection fees received from the beneficiary households. These revenues were important to meet the operational and maintenance costs of the composting project. If the revenues of the composting projects are more than the cost of composting then the composting projects would be financially worthy.
Cost savings are not the direct revenues but the avoided costs. These savings could be from the reduction of waste management costs and potential extension of landfill capacity. These savings might be diverted as subsidies to support the composting projects, but would depend on the pro-environmental outlook of the local authority.
- Commercial value of the composting projects - Though small-scale community-based composting projects were not set-up for commercial purposes, a commercial proposition for the composting projects would be helpful to assess their business potential for private investment.

Capital and operational costs were investigated from the data gathered by means of interviews and questions supplied to the plant managers (Appendix-A). Capital costs of the composting projects studied were met from the financial support of donor agencies. Composting projects were labour-intensive and operational costs of the projects were accounted for on the basis of salaries of the labourers. Man-hours involved in the different processes of the composting projects were observed and recorded. The standard labour price in the market was taken into consideration for computing the salary costs of the labourers.

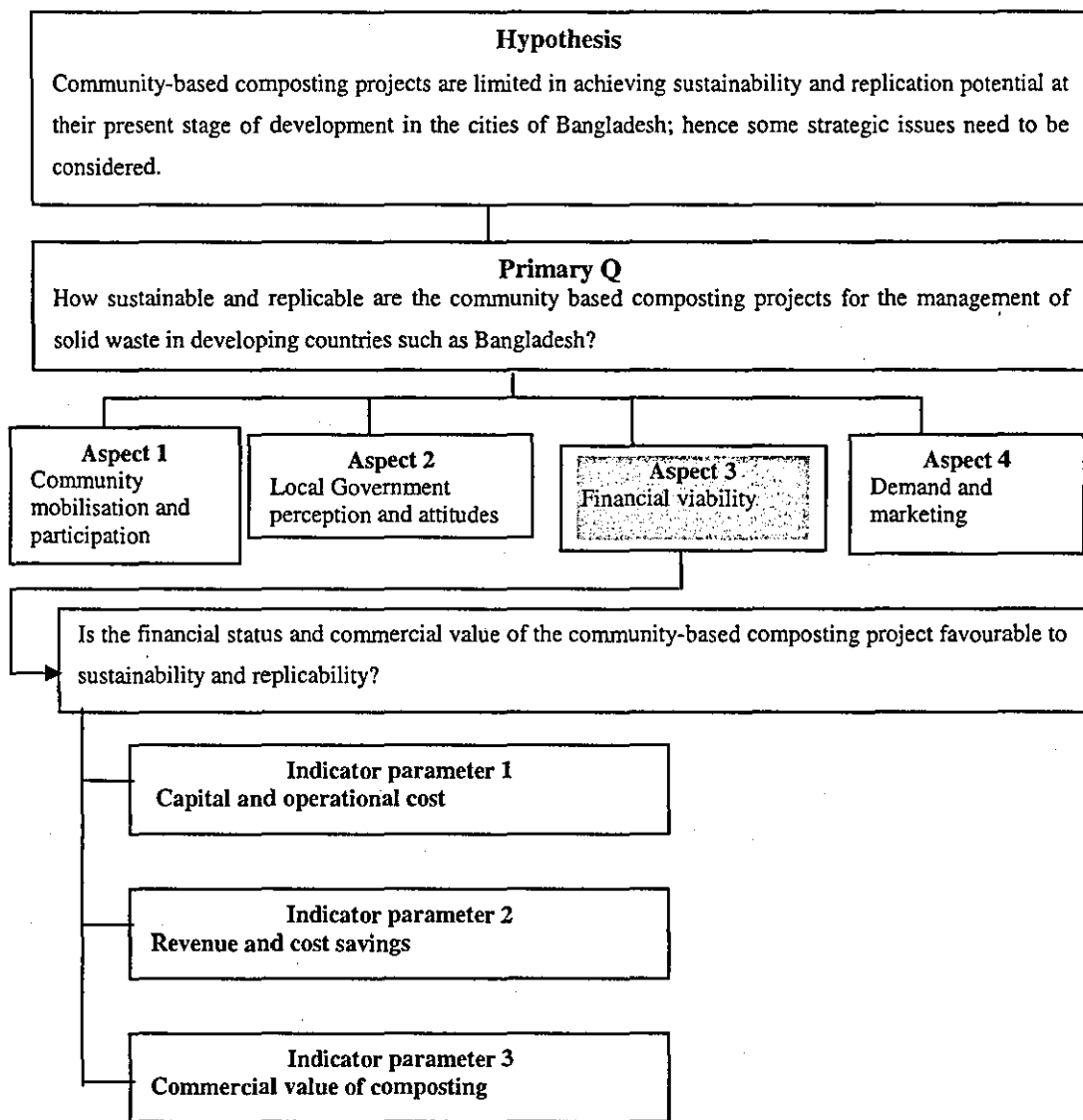


Fig 7.1 Research questions and indicators for the assessment of financial viability

In financial analysis, the depreciated capital costs, operation and management costs, maintenance costs, present value of the cash flow were accounted and some hidden costs were uncovered to get an actual picture of the project. Traditional cost accounting systems usually do not include the hidden costs and benefits (Hoornweg et al. 1999). Full Cost Accounting²⁸ (FCA) may help to reflect the actual financial status

²⁸ Full Cost Accounting (FCA) is a systematic approach for identifying and determining full cost of solid waste management services. It involves the identification and inclusion of all direct and indirect costs associated with a particular service for current and expected future outlays, support service (overhead) costs and operating costs. It also uncovers hidden and overlooked costs (EPA 1997). FCA is mainly used to understand expenditures associated with collection, disposal and recycling. It can also help to compare solid waste collection and disposal cost with the recycling cost.

of the project (EPA 1997). In this financial analysis a full cost accounting system was exercised to get the true financial situation of the composting projects. Full cost accounting generally refers to the process of collecting and presenting information (costs as well as benefits) to gain the actual financial reflection of a project. The community motivation and outreach costs, social and environmental benefits of the composting projects are difficult to quantify but these costs and benefits are needed to be factored in for identifying and determining the full cost of the solid waste management service (EPA 1997). Records on cost, expenditure and other financial matters were obtained from the plant operators on preformatted sheets, which were verified by interviewing the key informants of the projects.

7.2 Capital and operational cost

Capital costs are the initial investment costs to establish a project. They are generally one of the largest cost components in project expenditure (Kwon 2005). Capital costs in the composting project generally include:

- Land
- Facility construction
- Utility installation
- Equipment
- Waste collection vehicles

In Bangladesh, the community-based composting projects were funded by donor agencies for the purpose of demonstrating the resource value of waste and for helping the urban poor. Capital costs comprised waste collection vehicles procurement costs and composting facility construction costs. These capital costs were provided as grant money to support the pilot projects. Received gifts or grants, regardless of how they were acquired, have value and that value reduces over time with the use. Waste collection vans and composting facilities had different depreciated lifetimes. The economic life of the waste collection vehicles and facility structures were considered to be 5 years and 10 years respectively. Depreciation is a method for allocating the costs of capital outlays over the useful life of the resource and defined by the mathematical expression:

$$D = C \frac{r}{1 - \frac{r}{(1+r)^n}}$$

{ r = Bank interest rate(15%)
 n = Useful life
 D= Depreciation value
 C = Cost }

To implement a composting facility, the project first needs to acquire land. The land may be donated by the government or may be purchased or rented. In Dhaka, Waste Concern got the option of getting government lands for the composting facilities free of cost, so no outlays were recorded or anticipated in their financial cost analysis. Free use of land is a hidden cost²⁹ which needs to be considered in the financial cost analysis for true reflection of the cost figures.

Land would be a big capital investment for the composting facility. According to Waste Concern around 380 m² space might be required for a 3 ton capacity compost plant (Enyetullah and Sinha 2000). In the Prism project at Khulna and the Sylhet Partnership Company project at Sylhet, lands were obtained at a cheap lease price of Tk.12/ m²/ year (Chowdhury 2004; Saha 2003). The land price in Dhaka city was extremely high, from £130/ m² to £215/ m² (World Bank 2000). NGOs such as Waste Concern, could be able to manage government lands for composting free of charge. But this might not be possible for other NGOs or enterprises and it would not make economic sense to buy land for composting at a high price. For a fair reflection of land cost in capital outlays, rented land cost could be added into cost calculations. An average estimated rental value of Tk.80/ m²/year was assumed on the basis of the market rate in Dhaka. The rented or leased land costs were considered fixed over the entire lifetime of the project.

The plant equipment and accessories such as aerators, shovels, screens, buckets etc. have very short life and their costs were accounted as annual consumables. Box structures (perforated brick enclosures) were used in two projects as replacements for the aerators and were assigned a depreciation time of 10 years. The utility facilities such as water and electricity connections were provided by the government as part of the agreement. These costs were accounted for as hidden costs in the financial calculations. Raw materials such as sawdust and cow-dung/poultry litter were needed

²⁹ Hidden costs are related to inputs for which no expenditure has been made by the compost manufacturer.

to mix with the organic wastes for balancing carbon-nitrogen (C/N) ratio. Provision for annual fixed costs was included for purchasing these materials.

In operation and maintenance, two types of costs were accounted. One was the overheads and maintenance costs that included management and support staff salaries, utility bills, van repairs and office equipments. These costs were considered fixed on an average over the project period. Another was the operational cost, the expenses of managing composting activities on a daily basis. These costs were mainly the salaries of the workers involved in the waste collection and composting process. The operational costs of the composting project were computed on the basis of man-hour involvement in different processes of the composting operation. Some hidden costs i.e. the costs of activities or resources that appeared to be free for the project were uncovered. In the composting projects hidden costs were the personnel costs for spending time and effort for community mobilisation and sensitisation activities. This input was essential at the initial stage of the project and was included in the salary costs of support staffs who worked as social mobilisers for the projects.

Cost per ton is an indicator for the determination of viability of a composting project, which could be obtained by dividing total project costs with the amount of annual waste processed. In Dhaka, Waste Concern was running three composting plants at Mirpur (5 ton capacity), at Green road (1 ton capacity) and at Dhalpur (3 ton capacity). The plants were not financially attractive. The cost per ton was comparatively higher than the composting projects in India and Mali (Dulac 2001). In general, the greater the volumes of wastes processed, the lower would be the unit cost because the fixed costs are spread over larger quantities of wastes. This is called economy of scale, which could be reached when the processes of the composting activity are run at their optimal capacity. Table (7.1) represents an overview of the investment, maintenance and operational costs of the composting projects in Dhaka.

Table 7.1 Investment, overhead and operational cost				
Cost components	Unit cost	1 ton capacity (Green Road plant)	3 ton capacity (Dhalpur plant)	5 ton capacity (Mirpur plant)
Investment cost				
Land (rent)	£ 0.70/m ² /yr	£94 (134 m ²)	£266 (380 m ²)	£ 350 (500 m ²)
Plant shed and office building construction (Economic life 10 years)	£ 14/ m ²	£1610 (115 m ²)	£3416 (244 m ²)	£3920(280 m ²)
Depreciation costs of		£322	£683	£784

plant shed and office building				
Rickshaw van (Economic life 5 years)	£105 per van	£315 (3 Nos.)	£420 (4 Nos.)	£525 (5 Nos.)
Depreciation costs of rickshaw vans		£95	£126	£158
Plant equipment and accessories	annual (average)	£151 (4 box)*	£254 (6 box)*	£280 (20 aerator)
Water and Electricity connection	annual (average)	£20	£20	£20
Uniform of workers	£3/uniform (annual)	£15 (5 collectors cum plant workers)	£18 (6 collectors cum plant workers)	£36 (7 collectors & 12 plant workers)
Raw materials Sawdust(1.5%wt. of organic waste)	£0.02/kg	£48 (2396 kg/year)	£150 (7455 kg/year)	£234 (11715 kg/year)
Cow-dung/ Poultry litter[Cow-dung/Poultry litter : organic waste (1:20)]	£0.01/kg	£80 (7988 kg/year)	£248 (24850 kg/year)	£390 (39050 kg/year)
Total investment cost		£825	£1765	£2252
Overhead and maintenance cost (Annual)				
Staff salary	annual including benefits	£979 (1 plant supervisor & 1 assistant)	£1497 (1 plant supervisor & 2 assistants)	£1497 (1 plant supervisor & 2 assistants)
Rickshaw van repair (5 % of the purchase price)	annual (average)	£16	£21	£26
Water & electricity bill	annual (average)	£25	£30	£35
Total Overhead and maintenance cost		£1020	£1548	£1558
Operational (labour) cost (Annual)				
<u>Collection</u> Salary of collectors (355 working days)	£0.15/hr	£568 (10.67 man-hour/day)	£639 (12 man-hour/day)	£746 (14 man-hour/day)
<u>Sorting</u> Salary of plant workers (355 working days)	£0.15/hr	£80 (1.5 man-hour/day)	£80 (1.5 man-hour/day)	£160 (3 man-hour/day)
<u>Piling & Turning</u> Salary of plant workers (355 working days)	£0.15/hr	£53 (1 man-hour/day) (No turning required)	£53 (1 man-hour/day) (No turning required)	£292 (5.5 man-hour/day)
<u>Screening</u> Salary of plant workers	£0.15/hr	£133 (2.5 man-hour/day)	£372 (7 man-hour/day)	£400 (7.5 man-hour/day)
<u>Bagging</u> Salary of plant workers	£0.15/hr	£17 (0.325 man-hour/day)	£44 (0.83 man-hour/day)	£53 (0.99 man-hour/day)
Total operational cost		£851	£1188	£1651

Total annual project cost	£2696	£4501	£5461
Total waste collected	650kg/day	1600kg/day	2700kg/day
Total organic waste collected	450kg/day	1400kg/day	2200kg/day
Total compost produced	100kg/day	265kg/day	297kg/day
Cost of composting/ton (including waste collection cost)	£12/ton	£8/ton	£6/ton
Cost of composting /ton (excluding waste collection cost)	£9/ton	£7/ton	£5/ton
Cost of composting/ton at full capacity	£8/ton	£4/ton	£3/ton

[* Box structures depreciated over 10 years]

From the field observation and man-hour monitoring of the composting plants in Dhaka city, it was found that the composting plants were running at half of the designed capacity. At the present stage of compost production in the 1 ton, 3 ton and 5 ton capacity plant, costs of composting (including waste collection cost) were £12/ton, £8/ton and £6/ton respectively. In the 1 ton and 3 ton capacity plants at Green Road and Dhalpur, 5 to 6 workers were engaged in both the waste collection and composting activities. At Mirpur, in the 5 ton capacity plant, 7 part time (for collection) and 12 full time (in compost facility) workers were engaged and consequently it was found that cost of production per ton was higher. In Mali, a 2 ton capacity compost plant involving 3 workers was running efficiently with a lower production cost (US\$4/ton) (Dulac 2001). Lardinois and Marchard (2000) analysed the financial feasibility of three small-scale composting plants in Bangalore, Kathmandu and Manila, and found that small-scale composting projects were not financially attractive due to high production costs.

7.2.1 Waste collection cost

Primary waste collection was an integral part of the community-based composting project. Manually operated rickshaw vans were used in door-to-door waste collection service. One rickshaw van could only cover a 1km² area and spend 4 to 5 hours on waste collection (Field observation 2004). This incurred expenditure of about 20 percent of the total project costs. Households used to pay waste collection fees to run the service. Waste collection fees from households could not always meet the expenditure of the waste collection services which were thus faced with a shortfall (Table 7.2).

Table 7.2 Total door-to-door waste collection cost for different capacity composting plants			
Capital and operating cost for waste collection	1 ton capacity compost plant at Green road	3 ton capacity compost Plant at Dhalpur	5 ton capacity compost plant at Mirpur
Depreciation cost of rickshaw van	£95	£126	£158
Repair and maintenance cost of rickshaw vans	£16	£21	£26
Uniform	£15	£18	£21
Salary cost	£568	£639	£746
Total expenditure for waste collection	£694	£804	£951
Total income from waste collection fees	£528	£624	£1788
Percentage of waste collection cost over total project costs	26%	18%	17%
Surplus(+) /shortfall(-) from waste collection service	(-)24%	(-)22%	(+)88%

7.2.2 Land cost

Windrow composting is a land-intensive process. The space required for composting is proportional to the windrow/pile dimensions and the number of windrows /piles (UNEP-IETC 1996). At Mirpur composting plant, Waste Concern experimented with windrow piles, which occupied 50 percent of the project area (Rytz 2001). To economise on land space, Waste Concern replaced windrow piles with Box type composting³⁰ arrangements in two composting plants at Green Road and Dhalpur. The box structure could accommodate 6 to 7 days wastes and save 1.5 times the land required for the windrow pile. In addition, it could curtail the turning cost.

Land cost was a large capital expenditure of the composting project and normally a constraint. It will not make economic sense to purchase land for composting at a higher price. A provision of land cost (rental) had been considered in the financial analysis of Waste Concern's Project similar to the Khulna and Sylhet projects. It was estimated in the financial outlay that land cost (rental) involved 11 to 15 percent of the total capital expenditure and 3 to 5 percent of the total project cost.

³⁰ Box type composting is a perforated brick enclosure with perforated vertical plastic pipes embedded in the pile. This type of composting process was operational at Dhalpur and Green Road, Dhaka and at Sylhet.

7.2.3 Labour cost

Community-based composting projects were labour-intensive and operational costs were mainly accounted for on the basis of the salaries of the labourers. From the financial analysis, it was observed that labour costs accounted for about 30 percent of the total project costs.

7.2.3.1 Economy of scale

The economy of scale is an important factor for ensuring cost efficiency of the composting project. The economy of scale could be reached when different parts of the process operate at their optimal capacity. It depends on the productivity of labour, the amount of raw materials processed and the design capacity of the system (Dulac 2001). Table 7.3 shows the productivity of labour at different steps of the composting process. It was observed in manual sorting at Dhalpur plant that the efficiency of the labour was high. This was due to the fact that more than 50 percent of the raw solid wastes of this plant were brought from the vegetable market and little effort was required for sorting. But for sorting the rest 700 kg of mixed solid wastes, the labour productivity was 77kg/hour, nearly the same as the other composting plants. It was found from the financial cost analysis and labour productivity that source separation of waste could save the manual sorting cost by 10 percent of the total operational cost. The productivities of labour in waste piling and turning in Green Road and Dhalpur plants were higher than the Mirpur plant because turning was not required for box type arrangements.

In screening, the productivity of labour was low because screening was done in three stages with the same size (8 mm) sieve. A more efficient way of increasing the productivity of sieving would be to pass the compost through coarse-medium-fine screens. The productivity of screening of Waste Concern's compost ($0.02 \text{ m}^3/\text{hour}$) was much lower than that recorded in India [$0.5 - 0.8 \text{ m}^3/\text{hour}$] (Dulac 2001). In bagging, the productivities of labour at the Mirpur plant was low. In the Mirpur plant, 7 waste collectors and 12 compost workers were involved in primary waste collection and composting activity respectively. But in the Green Road and Dhalpur composting plants 5 and 6 workers respectively were involved in both waste collection and

composting activities. In the Mirpur plant, the labourers were not efficiently utilised and as a whole the productivity was low in comparison to other composting plants.

Activity of the composting process	1 ton capacity (Green Road Plant)	3 ton capacity (Dhalpur plant)	5 ton capacity (Mirpur plant)
Total incoming waste	650kg/day	1600kg/day	2700kg/day
Organic waste	450kg/day	1400kg/day	2200kg/day
Matured compost	190kg/day	500kg/day	565kg/day
Manual sorting	87kg/hour	177kg/hour	75kg/hour
Piling and Turning	90kg/hour	103kg/hour	33 kg/hour
Screening	15kg/hour (0.02 m ³ /hour) ³¹	12kg/hour	6kg/hour
Bagging	62kg/hour	53kg/hour	25kg/hour
Total processing efficiency of one labourer	254kg/hour	345kg/hour	139kg/hour

7.2.3.2 Cost per ton

The cost per ton is very sensitive to the volume of waste processed. The higher the capacity of the plant, the lower would be the unit cost to make it financially attractive. Fig 7.2 shows that the cost of composting decreases when large volumes of wastes are processed in the compost facility. Cost-effectiveness of the project is achieved at the lowest cost per ton for the desired level of service. The waste management cost³² in Dhaka city was £5/ton. At the present state of waste processing in all composting facilities, the cost of composting is higher than the waste management cost. If the 3 ton and 5 ton capacity plant were to be run at full capacity, the cost of composting could be done at a cheaper rate than landfill. If the cost of composting is found to be more than the landfill cost, composting could not be financially attractive as a waste disposal option.

³¹ Density of raw waste materials 350 kg/m³ and matured compost 630 kg/m³ (Dulac 2001)

³² Total expenditure in solid waste management in 2002- 2003 was Tk. 480 million and waste generation in Dhaka city 3200 ton/day (Source: JICA 2005)

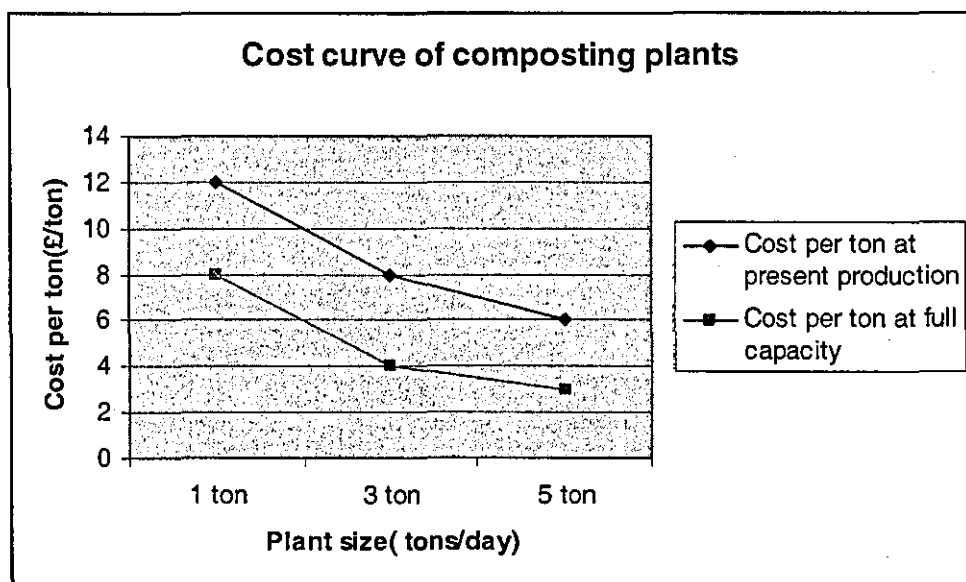


Fig 7.2 Cost per ton at different capacity of compost plant of Waste Concern

In comparison to total project cost and cost per ton of waste processed in a 3 ton compost plant in three different cases, at Dhaka, Khulna and Sylhet (Table 7.4), it was observed that capital cost in the Khulna project was higher because the community households were provided with waste storage containers for a uniform waste collection service in the communities.

In Waste Concern's Dhalpur project, the overhead cost was more because two assistants were engaged to collect waste collection fees and to mobilise the community. However, in the Khulna and Sylhet projects, waste collectors were usually used to collect fees from households.

Item	3 ton capacity plant of Waste Concern at Dhalpur, Dhaka	3 ton capacity plant of Prism at Khulna	3 ton capacity plant of Sylhet Partnership company
Capital or investment cost	£1756	£2395	£1955
Overhead or maintenance cost	£1548	£364	£580
Operational or labour cost	£1188	£1610	£2099
Total project cost	£4501	£4369	£4634
Cost per ton of waste processed	£8/ton	£5/ton	£4/ton

In the Khulna and Sylhet projects, operational costs were higher because the composting plants were not located near to the community. The rickshaw vans used to travel a long distance (2 to 3 km) for collecting waste. To make the composting projects financially viable, it would be better to site the facility near to the community (UNEP-IETC 1996). From the overall project cost, it was observed that in Sylhet, the project cost was high but the cost per ton was low because the plant was running at its maximum capacity.

From the investment and operational cost analysis, it was observed that financial viability of the composting projects of Waste Concern was difficult to achieve at their present stage of operation. This might happen due to the fact that the projects were neither able to secure the requisite wastes to run the facility at designed capacity nor were able to achieve economies of scale for financial success. The composting projects were labour intensive and salaries accounted for the largest share of the operating costs. During man-hour monitoring, it was observed that composting plants were over-staffed and the workers had more idle time. In two projects, the same workers were engaged in both waste collection and composting activities. This was economic and ideal for the proper utilisation of labourers because household wastes were usually generated by midday. In Bangladesh, the cost per ton of composting was comparatively higher than in the composting projects (1 to 5 US\$) in India and Mali (Dulac 2001) and would not be viable in the financial sense.

Key points

- Waste collection cost incurred 20 percent of the total project cost. The closer the distance of the composting facility to the community, the lower would be the waste collection cost.
- Land cost involved 11 to 15 percent of the total capital expenditure and 3 to 5 percent of the total project cost. For saving space, box-composting might be more economic than the windrow composting.
- Labour cost involved about 30 percent of the total project cost. If the labourers were utilised optimally, this could increase productivity of the plant and thus save a significant amount of cost.

- Source separation could save manual sorting cost by 10 percent. In Bangkok, it was estimated by Kim (1995) that a quarter of the cost of compost production could be reduced through source-separation.
- At the present stage of waste processing in the composting facility, the cost of composting was higher than the cost of waste management. If the composting projects could run at optimal capacity, the cost per ton might be reduced and financial viability would be achieved.

7.3 Revenue and cost savings

Composting is a revenue earning undertaking. Three types of revenue can be generated from composting activities (i) revenues from collection fees charged against primary waste collection service (ii) income from sale of compost and (iii) income from sale of recyclables. Another contribution of composting is the economic benefit obtained from waste management cost reduction and extending landfill capacity. Financial sustainability of the composting project can be ascertained by accounting the revenues generated from the sale of compost and the savings of waste disposal cost and landfill space. Sale of compost is still a problem due to the lack of market development for the product (Hoornweg et al. 1999). Another problem of the composting project is the lack of motivation of local government for transferring the savings of waste collection and disposal costs towards the composting activity as a subsidy (Diaz et al. 1993). Three assumptions were made in the financial analysis: (i) all the compost produced in the composting facility could be sold (ii) primary waste collection was considered the integral part of the composting scheme and (iii) financial savings from waste collection and disposal would be part of the waste reduction strategy of the local government.

7.3.1 Revenues from composting activity

Household waste collection, recyclable sorting and compost production were the integral parts of the composting projects of Waste Concern. Households were contributing monthly waste collection fees of Tk.10 to Tk.20 to share the operational costs of the projects. Mixed wastes were sorted out in the composting facility to

reclaim the recyclables such as plastic, glass, metal, cardboard etc. Recyclables were sold by the plant workers which brought extra income for them. This income was included in the financial analysis to get an overall picture of the resource value of wastes. Waste Concern used to sell compost at Tk.2.5/kg in bulk to a private fertiliser and pesticide distribution company. Table 7.5 shows an overall picture of the revenues earned at the present level of compost production in three different composting facilities. From the statements of composting projects, it was found that revenues from the collection fees contributed 35 percent of the total income and covered 20 percent of the total project cost. Income from the compost sale covered 40 percent of the total project cost and 65 percent of the project operation and maintenance cost. At the present state, all the projects (1 ton to 5 ton) were running at a shortfall of about 40 percent. If the projects would run at full capacity, even then the 1 ton capacity project might incur a loss, but the 3 ton and 5 ton capacity projects could make profit. The profit margin indicated that the repayment of the capital investment of the projects or future investment would be possible.

Item	1 ton capacity compost plant at Green Road	3 ton capacity compost plant at Dhalpur	5 ton capacity compost plant at Mirpur
Revenues from collection fees	£528	£624	£1788
Income from recyclables	£108	£94	£125
Income from compost sale	£772	£2045	£2292
Total income with recyclables	£1408	£2763	£4205
Total income without recyclables	£1300	£2696	£4080
Total project cost	£2696	£4501	£5461
Shortfall/profit with recyclables	-£1288(48%)	-£1783(39%)	-£1256(23%)
Shortfall/ profit without recyclables	-£1396(52%)	-£1805(40%)	-£1381(25%)
Total project cost at full capacity	£2840	£4260	£5325
Total income at full capacity	£2459	£5270	£8071
Shortfall/profit at full capacity	-£381(13%)	+£1010(24%)	+£2746(52%)

Waste Concern's composting plants were running at a shortfall. But in comparison with the 3 ton capacity composting plants in Khulna and Sylhet (Table 7.6), it was found that the 3 ton capacity compost plants could make profit if the maximum production target could be reached and all composts could be sold. The repayment of the initial investment could be made within 7.5 years in the case of Prism and 4 years in the case of the Sylhet Partnership, using the cost recovery factor (for Prism 0.23 and for Sylhet partnership 0.34) in an iterative process.

$$\text{Cost recovery factor CRF} = \frac{r(1+r)^N}{(1+r)^N - 1}$$

where r = bank interest rate (15%) and N= repayment period in years

Table 7.6 Comparison of project revenues of 3 ton capacity compost plant run in three different cities in Dhaka, Khulna and Sylhet.

Item	3 ton capacity plant of Waste Concern at Dhalpur, Dhaka	3 ton capacity plant of Prism at Khulna	3 ton capacity plant of Sylhet Partnership Plant at Sylhet
Revenues from collection fees	£624	£2087	£1670
Income from recyclables	£94	£125	£94
Income from compost sale	£2045	£3141	£4445
Total income	£2763	£5353	£6209
Total project cost	£4501	£4369	£4634
Shortfall/profit	-£1738(39%)	+£984(23%)	+£1575(34%)

7.3.2 Reduction of waste management cost

Community-based composting projects may be attractive to a municipal authority as they contribute to reduction of waste transportation and disposal costs. Composting can save three types of cost for the municipality: (i) waste transportation cost (ii) landfill space cost and (iii) disposal and landfill management cost. These potential savings are avoided costs not revenue. These costs may be accounted for as contributing to the composting costs and subsidizing the composting activity. The viability of a composting facility can be established by knowing the difference between benefits and costs i.e. the net benefits generated.

$$\begin{aligned} \text{Net benefits} &= (\text{total benefits}) - (\text{total costs}) > 0 \\ &= \{\text{revenue} + \text{cost saving}\} - \{\text{capital costs} + \text{operation and maintenance costs}\} > 0 \end{aligned}$$

A project is worthwhile, when the benefits exceed the costs. It was found from the composting projects of Waste Concern (Table 7.7) that when the revenue and landfill savings costs were taken into consideration, they exceeded the cost of composting, which indicated the potential financial viability of the project.

Table 7.7 Reduction of waste management cost due to composting

Item	1 ton capacity plant at Green Road	3 ton capacity plant at Dhalpur	5 ton capacity plant at Mirpur
a. Waste fraction need not to be transported and dumped			
Organic waste used for composting	450kg	1400kg	2200kg
Recyclables sorted out for resale	100kg	50kg	375kg
b. Rejects need to be transported and dumped by municipal authority			
Rejects after sorting	50kg	115kg	125kg
Rejects after screening	14kg	35 kg	40kg
Reduction of waste for transportation and disposal (a-b)	486kg	1300kg	2410kg
Waste management cost of Dhaka City Corporation(DCC)	£5/ton		
Reduction of waste management cost of DCC due to composting	£863	£2308	£4278
c. Reduction of landfill cost			
Landfill spaced saved	29m ²	77m ²	143m ²
Cost of purchasing land for dumping around Dhaka City	£15/m ²		
Cost reduction for landfill area saving (yearly)	£435	£1155	£2145
Total cost reduction of DCC due to composting (yearly)	£1298	£3463	£6423
Total income from composting	£1408	£2763	£4205
Total benefits from composting	£2706	£6226	£10628
Total cost of composting	£2696	£4501	£5461
Net benefits	+£10	+£1725	+£5167

Key points

- From the present state of operation of the composting projects, it was found that revenue from collection fees contributed 20 percent and compost sale covered 40 percent of the total project cost. All the projects (1 ton to 5 ton) were running at a shortfall at the present level of compost production.
- If the projects could be run at full capacity, even then the 1 ton capacity plant might incur a loss but the 3 ton and 5 ton capacity plants could make profit.
- In full scale operation, the 3 ton capacity composting plants of Khulna and the Sylhet project could recover the investment cost within 7.5 years and 4 years respectively.
- The composting projects would be financially worthwhile if all the revenues and landfill potential saving costs were accounted for in the financial analysis.

7.4 Commercial value of composting project

A composting project has commercial value. It contributes to a substantial amount of revenue for subsidising or sharing the cost of operation. The community-based composting projects were not set up for commercial purposes. The commercial value of the projects was worked out to assess the business potential of the composting projects for private investment. Commercial viability can be measured by Net Present Value (NPV) (Horne and Wicz 2001). Net present value is the difference between the present value of the revenue stream and the present value of the cost stream of a project. NPV can be computed by a discount rate which represents the decrease in value of equivalent benefits and costs in the future compared to the present. When the NPV is greater than zero (positive), the project is commercially viable. When the value is negative or close to zero, this indicates that external funding is required to finance the project.

$$PV^t = \frac{C^t}{(1+r)^{t-1}},$$

Where PV = Present value, C = Cost incurred, r = Bank interest rate (15%) and t = Estimated economic life of the project.

In this exercise, investment costs are discounted at bank interest rate to get the present value of the future cost. The operation and maintenance costs, revenues and potential savings are considered fixed throughout the estimated life of the project. From the analysis (Table 7.8), it was found that none of the composting projects (1 ton to 5 ton) were commercially viable. Even when the potential landfill savings were included in the financial calculation, the 1 ton capacity compost plant did not make commercial sense but the 3 and 5 ton capacity plants were found to be commercially viable. At the present state of production, the community-based composting projects could not survive independently without external support or without enjoying the subsidy of the local authority.

Table 7.8 Commercial viability of the project**Net Present Value of 1 ton capacity compost plant at Green Road , Dhaka**

Item \ Year	1	2	3	4	5	6	7	8	9	10
Investment cost (£)	2333	2059	1821	1615	1570	1396	1245	1114	999	900
Operation and maintenance cost (£)	1871	1871	1871	1871	1871	1871	1871	1871	1871	1871
Revenues (£)	1408	1408	1408	1408	1408	1408	1408	1408	1408	1408
Present value (£)	-2796	-2522	-2284	-2078	-2033	-1859	-1708	-1577	-1462	-1361
Landfill saving cost (£)	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298
Present value including landfill saving	-1498	-1224	-986	-780	-735	-561	-410	-279	-164	-63

Net Present Value = - 6700

The project is not commercially viable

Net Present Value of 3 ton capacity compost plant at Dhalpur, Dhaka

Item \ Year	1	2	3	4	5	6	7	8	9	10
Investment cost (£)	4792	4255	3790	3384	3212	2882	2595	2345	2128	1939
Operation and maintenance cost (£)	2736	2736	2736	2736	2736	2736	2736	2736	2736	2736
Revenues (£)	5353	5353	5353	5353	5353	5353	5353	5353	5353	5353
Present value (£)	-2175	-1638	-1173	-767	-595	-265	+22	+272	+489	+678
Landfill saving cost (£)	3463	3463	3463	3463	3463	3463	3463	3463	3463	3463
Present value including landfill saving	+1288	+1825	+2290	+2696	+2868	+3198	+3485	+3735	+3952	+4141

Net Present Value = +29478

The project is commercially viable including landfill saving cost

Net Present Value of 5 ton capacity compost plant at Mirpur , Dhaka

Item \ Year	1	2	3	4	5	6	7	8	9	10
Investment cost (£)	5755	5175	4671	4233	4076	3717	3402	3093	2901	2685
Operation and maintenance cost (£)	3209	3209	3209	3209	3209	3209	3209	3209	3209	3209
Revenues (£)	6209	6209	6209	6209	6209	6209	6209	6209	6209	6209
Present value (£)	-2755	-2175	-1671	-1233	-1076	-717	-402	-93	+99	+315
Landfill saving cost (£)	6423	6423	6423	6423	6423	6423	6423	6423	6423	6423
Present value including landfill saving	+3668	+4248	+4752	+5190	+5347	+5706	+6021	+6330	+6522	+6738

Net Present Value = + 54522

The project is commercially viable including landfill saving cost

7.5 Commercial value of compost

Compost is a source of valuable minerals and organic matter. The utility of compost as a soil conditioner has long been recognised but its application as a source of soil improvement for crop cultivation is still largely untapped (Diaz et al. 1993). Compost usually contains major nutrients like nitrogen (N), phosphorus (P) and potassium (K) in a lower percentage than chemical fertilisers (Dalzell et al. 1979). In comparison to nutrient content and market price, a price equivalency was made to determine the commercial value of compost despite the other potential benefits usually assigned to compost. Compost has special characteristics and values for its organic matter and micro-nutrients or trace elements such as iron, manganese, copper, boron, zinc, molybdenum etc. These elements were not taken into account as no such amendments exist in major chemical fertilisers like urea, triple super phosphate (TSP) and muriate of potash (MP), commonly used by the farmers in Bangladesh. It has to be noted that chemical fertilisers were subsidised by the government and were available in the market at a cheaper price. Table 7.9 shows an equivalent price or substitute price of major elements (N-P-K) of chemical fertiliser, waste derived compost and other locally available organic fertilisers (After Rytz 2001). The nutrient contents of the chemical fertilisers and organic inputs such as cow dung and poultry litter were taken from the fertiliser recommendation guideline of Bangladesh (BARC 1997) and for the composts were taken from the laboratory test results provided by the compost manufacturers. Prices were taken from the market and in some cases from the manufacturers.

Chemical fertilisers/compost	Nutrient content in percentage	Price (Tk/kg)	Price of equivalent N in kg (commercial value)	Price of equivalent P in kg (commercial value)	Price of equivalent K in kg (commercial value)
Urea	46% N	6.50	14		
TSP	48% P ₂ O ₅ (21% P)	11		53	
MP	60% K ₂ O (50 % K)	8			16
Compost of Waste Concern, Dhaka	2.28% N, 1.87% P, 2.17% K	2.5	109 (0.13)	134 (0.4)	115 (0.14)
Blended compost of Waste Concern	2.4% N, 15% P, 10% K	15	625 (0.02)	100 (0.53)	150 (0.11)
Compost of Prism, Khulna	1.75% N, 1% P, 2.27 % K	2	114 (0.12)	200 (0.27)	88 (0.18)
Compost of Sylhet Partnership Company	1% N, 0.5% P, 0.5% K	3	300 (0.05)	600 (0.09)	600 (0.03)
Cow dung	1.34% N, 0.39 % P, 0.7% K	0.50	37 (0.38)	128 (0.41)	71 (0.23)
Poultry litter	1.60% N, 0.65% P, 0.7% K	0.50	31 (0.45)	77 (0.69)	71 (0.23)

In a comparison of compost with chemical fertiliser in terms of nutrient content and price, it was found that the commercial value of Waste Concern compost reached only 27 percent of the selling price and blended fertiliser reached 4 percent of the selling price. At the present price, it would be difficult for compost or blended compost to gain a position in the fertiliser market with regard to its commercial value. The locally available organic inputs such as cow dung or poultry litter had a large commercial value of more than 200 percent in terms of selling price and fertiliser value, and were in a more favourable condition than the waste derived compost. Compost would not be competitive or a substitute for chemical fertiliser in terms of fertiliser value and price but could complement the chemical fertiliser, allowing it to remain in the soil matrix for a longer time and thus increase nutrient supply to the plants.

Key points and discussion

- 3 ton and 5 ton capacity composting plants would only be commercially viable, when the revenue and potential landfill saving costs were included in NPV calculation.
- At the present price, it would be difficult for compost or blended compost to compete with chemical fertilisers in terms of price and fertiliser value.

- The locally available organic inputs such as cow-dung and poultry litter were in a more favourable commercial condition than the waste derived compost in comparison to price and nutrient content.

The potential savings from waste transportation and disposal costs are essential for the composting projects to run on a commercial basis. At the present levels of motivation and awareness, it would be difficult to convince or manage the local authority to provide a subsidy for the composting project from the potential savings. The small-scale composting plants were producing little compost and the selling price was comparatively higher. In comparison to fertiliser value and price, compost was in an inferior position to the chemical fertilisers as well as other locally available organic inputs.

7.6 Summary of the chapter

This chapter discussed two important issues related to financial viability of the community-based composting projects: one was the economics of the projects and the other was the commercial value of the projects. In this chapter the research was guided by the specific research question 'Is the financial status and commercial value of the community-based composting project favourable to sustainability and replicability?' to probe the hypothesis 'Community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered'.

Traditional cost accounting systems do not reflect the true costs and benefits of a project. In this chapter, a full cost accounting approach was exercised for gaining the true financial status of the projects. All the actual and hidden costs and associated benefits were unveiled and accounted for in the financial calculations. The financial viability of the composting projects was assessed by (i) determining net benefits of the project and (ii) computing the cost per ton.

From the financial analysis, it was found that community-based composting projects were unprofitable undertakings, heavily dependent on external support and unable to

cover the running costs of the projects. Some of the underlying issues relating to financial viability of the composting projects were:

- **Revenues from waste collection were not sufficient to subsidise the composting activity.**

Primary waste collection was the core activity of the composting programme. Waste collection incurred expenditure of about 20 percent of the project costs. Revenues from waste collection services could cover about 20 percent of the project costs. There would be little or no surplus to subsidize the composting activity.

- **Land could be made available free of cost in some cases but it was a major constraint for the composting project; so, land price (rental) was considered in the financial calculations.**

Composting is a land-intensive technology. Land cost comprises a large part of the capital expenditure and normally becomes a constraint for the composting project. Land prices are high in the cities and it will not make economic sense to purchase land for composting instead of taking leased or rented lands. Rouse (2004) and Zurbrugg et al. (2003a) observed that composting would not make a profit if it was established on rented or purchased land, and recommended reliance on donation of lands for composting. Rytz (2001) carried out a financial assessment on the Mirpur composting plant in Dhaka and opined that the land price was high and a major constraint for further replication of the composting project. This study found that land costs involved 3 to 5 percent of the total project cost, if land was taken as lease or rental.

- **Salary cost was a significant outlay in the small-scale composting project.**

The efficient use of labour could bring economies to the project.

Small-scale composting projects depend on manual labourers. Salaries of the labourers accounted for a large share, about 30 percent, of the total project costs. Man-hour monitoring and labour productivity showed that composting projects were overstaffed and labourers were not efficiently utilised which was a hindrance to making the project financially sound.

- **At the present state of production, the cost of composting was higher than the waste management cost, which might not be financially attractive as a waste disposal option.**

Cost per ton is a very sensitive indicator for assessing the financial status of a project. The composting projects of Waste Concern were running much below the designed capacity. At the present level of compost production, all the projects from 1 ton to 5 ton were running at a shortfall of about 40 percent. Even if the projects would run at full capacity, the 1 ton capacity compost plant might incur a loss, but the 3 ton and 5 ton capacity plants could make a profit. At the present state of composting operations, the cost of composting is higher than the waste management cost. The failure of the composting projects in developing countries is often due to the fact that inadequate attention is given to the economics of the scheme when it was designed and it was often found to be running below capacity (Niemeyer and Sanders 2003). Galab et al. (2004) also found that NGO projects cannot produce and sell enough compost to cover their capital and operational costs. Lardinois and Marchard (2000) analysed the financial feasibility of three small-scale composting projects at Bangalore, Kathmandu and Manila and found that small-scale composting projects were not financially feasible because they were producing too little compost and were not able to cover the initial investment costs.

- **Source-separation can considerably reduce the salary costs of the composting project.**

Waste sorting in the composting facility consumes a considerable amount of time, effort and money. Source-separation could save the manual sorting cost by 10 percent of the operational costs.

- **Composting could save a significant amount of waste transportation and landfill saving cost. If this cost could be converted into a subsidy for the composting project, it would make composting project financially and commercially viable.**

The composting projects would be worthwhile when all the revenue and potential landfill saving costs are accounted for in the financial calculations. From the financial analysis of Waste Concern's composting projects, it was found that none of the projects (1 ton to 5 ton) were commercially viable. Even when the potential landfill savings were included in the NPV, the 1 ton capacity compost plant did not make commercial sense although the 3 and 5 ton capacity plants were found to be commercially viable. Mbuligwe et al. (2002) observed that composting of organic waste could achieve a volume reduction of more than 60 percent and allow a

reduction in the landfill space exhaustion rate of more than 50 percent. Chakraborty (1999) analysed the economics of composting and found that the project would gain a surplus over the operational cost if the landfill saving costs were accounted for and even if the produced compost was distributed free of cost to the end users. Furedy (2004) gave the same opinion that if the financial savings of transportation and disposal of wastes were taken into consideration, composting would be found to be more attractive and more feasible for cities. The prevailing political environment in the local authority considered open dumping as cheap (Post and Buad 2004) and there was a lack of motivation of the local authority towards the savings of waste transportation and disposal. This needs the local authority to take a pro-environmental outlook for the transfer of the savings of waste transportation and disposal towards composting activities as a subsidy.

- **Compost as a fertiliser product is not attractive in terms of price and nutrient content.**

In comparison to nutrient content and price, it was observed that waste derived compost reached a commercial value of only 27 percent and blended compost of 4 percent of the chemical fertiliser selling price. At the present selling price and fertiliser value, it would be difficult for the waste derived compost to gain a competitive advantage in the fertiliser market over the chemical fertiliser and other locally available organic inputs such as cow-dung and poultry litter.

From this chapter, it can be concluded that in the community-based composting project, cost recovery was attainable only for primary waste collection services. It would be hard to recover the cost of composting, if the plants were not operated at designed capacity. NGOs and donors may consider community-based composting as a successful intervention for demonstrating the resource value of wastes, but not as a profit making undertaking. The sustainability or widespread replication of the composting projects is unlikely to take place unless financial returns are attained from the projects. This may also discourage the interest of the entrepreneurs as a viable business. Diversion of the waste transportation and landfill saving costs by composting into a subsidy could contribute to the financial and commercial viability of the composting project but the local government authority has not yet become

motivated or gained confidence in community-based composting as a waste disposal option.

Chapter 8

Demand and Marketing of compost

8.1 Introduction

The previous chapter pointed out that the earnings from the sale of compost could make a significant contribution (about 65 percent) to the operation and maintenance cost of the composting project. The literature reinforces the view that most of the composting projects were successful in producing compost but failed to sustain their activities due to lack of demand and poor marketing strategy of the product (Ali 2004; Diaz et al. 1993). Zurbrugg (2003) and Hoornweg et al. (1999) confirmed that demand and marketing were essential and integral parts of any successful composting programme. This chapter discusses the potentials and constraints of compost demand and marketing to measure the sustainability and replicability of community-based composting projects. Peter Doyle (1998) defined 'demand' as want for a specific product backed by an ability and willingness to pay for the product. Compost demand in this research context refers to the need for the product by potential customers at present and in the future. Therefore, demand may be created if the product works well, is readily available and is affordable to the potential customers. For creating demand the features and values of the product need to be communicated to the potential customers through advertisement and other promotional techniques. This is called the 'marketing strategy' of the product which is defined by the Chartered Institute of Marketing, UK as the management process which identifies, anticipates, and supplies customer requirements efficiently and profitably (Adapted from Kotler 2003). Marketing of compost in this research addresses two purposes: one is to sell the product and earn revenue by operating the project, and another is to reduce the backlog of stored compost which otherwise may cause stockpile of resource at the cost of money.

In this chapter demand and marketing of compost will be examined by the following specific research questions:

What is the present trend of organic compost production and consumption?

Is knowledge available to the end-users regarding the benefits and use of compost?

**What are the factors likely to affect the demand and marketing of compost?
 What marketing strategies are taken for the sale of compost and how do they
 influence the sustainability and replicability of the composting project?**

Present status of compost production and consumption, knowledge and awareness of potential users, factors constraining the demand and marketing, and marketing strategies, such as promotion and distribution of compost, will be taken into consideration to investigate the key research question of this research (Fig 8.1).

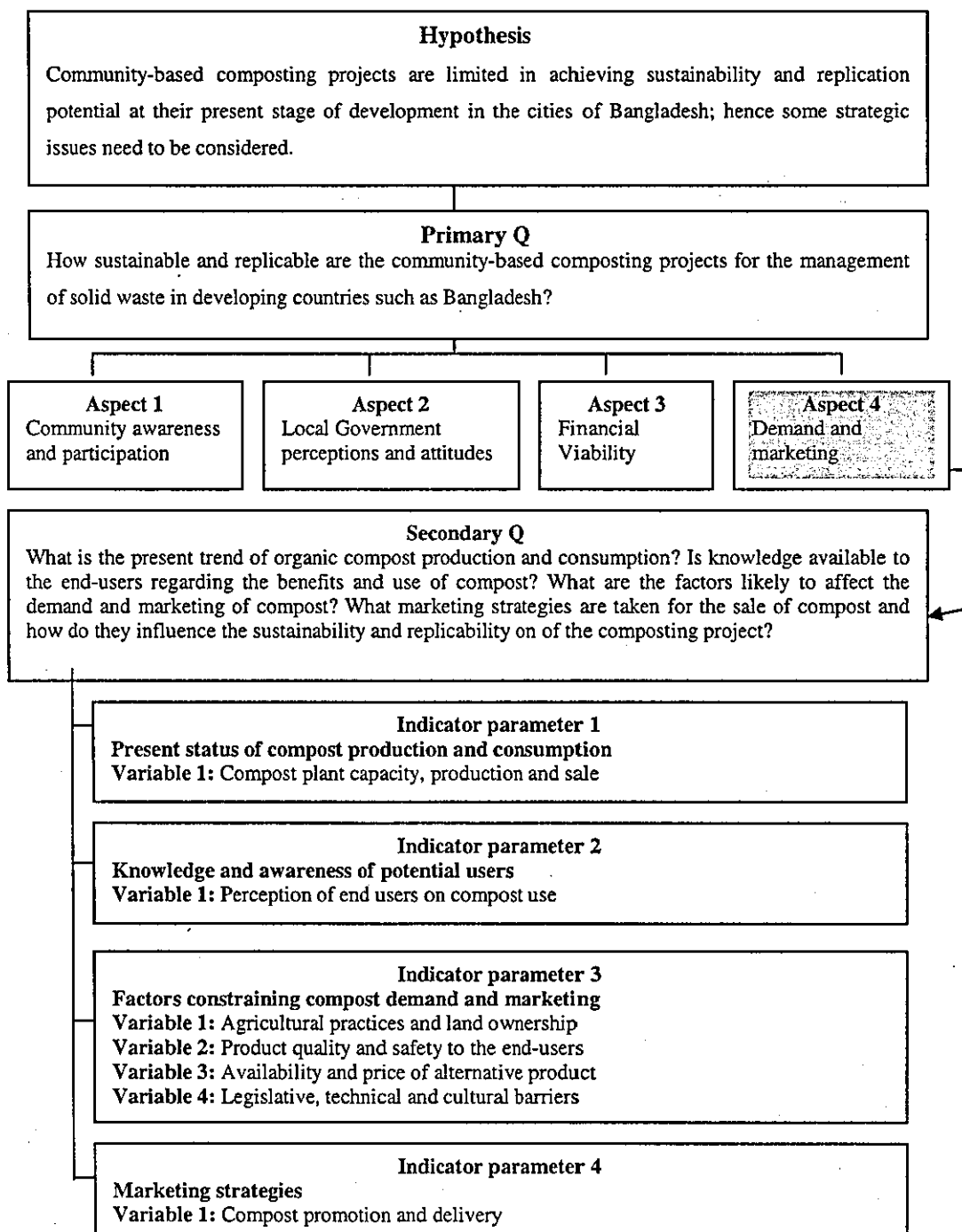


Fig 8.1: Research questions and variables for compost demand and marketing

Data and information were obtained from questionnaire surveys by interviewing farmers and nurseries with and without compost experience as outlined in section 3.7.2.2 of the methodology. Semi-structured interviews were conducted with the municipal authorities, organic fertiliser manufacturers, compost distributors and dealers, farmers and other potential users. Some laboratory test results, leaflets and record sheets were collected from the compost manufacturers and presented as factual references. Both qualitative and quantitative data were gathered and analysed. The quantitative data obtained from questionnaire surveys were analysed by SPSS software. The qualitative data obtained from the interviews are explained as statements and sometimes quoted where applicable. A summary of the key findings along with conclusions are drawn at the end of each section.

The trend of organic fertiliser production and consumption, knowledge and awareness of potential customers, constraints to demand and marketing, and marketing strategies will be discussed in the subsequent sections.

8.2 Present status of compost production and consumption

Community-based solid waste collection and composting was very new in the cities of Bangladesh. Waste Concern, a local NGO, first started community-based composting on a Public-Private-Community Partnership (PPCP) approach. It was operating three composting projects in Dhaka city. Prism, a national NGO, was operating two composting projects in Khulna city on NGO-CBO collaboration. Sylhet Partnership Company, a collaborative effort of London Borough of Tower Hamlets (UK) and Sylhet City Corporation, was running a composting project in Sylhet city. The present quantity of compost production in the facilities was a very insignificant percentage (in Dhaka city only 0.1 percent, in Khulna 2 percent and in Sylhet 2 percent) of the total waste generation³³ in the cities (Table 8.1). It was found from mass flow analysis of the composting projects that most of the plants were operating below the design capacity (Appendix A). This would happen because the plants were not designed on the basis of waste generation in the community or the market was not sufficiently

³³ Approximate daily generation of solid waste in Dhaka city 3200 ton (JICA 2005), in Khulna city 200 ton (Murtaza and Rahman 2000) and in Sylhet city 120-150 ton (Saha 2003).

developed to absorb the compost. The present production level of Waste Concern's composting (250 to 300 tons/year) is not enough to meet the demand. This reflected Waste Concern's estimate that the demand in the first year in 2000 was 200 ton but by 2004 it had increased to 15000 tons (Interview with Waste Concern in 2004, Appendix D). It indicates that the supply side was weak and could not meet the demand.

Compost project	Capacity of the plant	Incoming waste in the plant kg/day	Incoming organic waste in kg/day (percentage of incoming waste)	Compost production in kg/day (percentage of the organic waste)
Mirpur compost plant, Dhaka	5 ton/day	2700	2200 (81.48%)	297 (13.50%)
Green Road compost plant, Dhaka	1 ton/day	650	450 (69.23%)	100 (22.22%)
Dhalpur compost plant, Dhaka	3 ton/day	700 kg from household waste and 900 kg from vegetable market	1400 (87.5%)	265 (18.92%)
Barrel composting in Nasimbagh and Shah Ali Bagh Slum	In Nasimbagh 14Nos. and in Shah Ali Bagh 20 Nos. organic barrels (200 litre capacity) were installed. 120-150 kg composts are recovered from each barrel after 3 months.			
Compost Plant 1 at Boira, Khulna	3 ton/day	2350	1880 (80%)	407(21.64%)
Compost Plant 2 at Khalipur, Khulna	3 ton/day	2000	1575 (78.75%)	395(25%)
Sylhet Partnership Company plant at Shamimabad, Sylhet	3 ton/day	2200 kg from household waste and 800 kg from vegetable markets	2400 (80%)	480 (20%)

On the demand side, Map-Agro Industries was the main and regular customer of Waste Concern's compost. From the sale statement (Table 8.2), it is found that Map-Agro used to buy on average 15 tons of compost each month. Waste Concern made an agreement with Map-Agro to sell all its raw compost. Map-Agro then used to grind and blend the raw compost with chemical fertiliser and sold it through Alpha-Agro Ltd. - one of the largest pesticide and fertiliser distribution companies in Bangladesh. Alpha-Agro reported that it was facing problems in marketing the product due to shortage and irregularity of supply from Waste Concern, which indicates a demand for blended compost by the end-users (Box 8.1).

Proshika, an NGO promoting organic agriculture in Bangladesh, bought compost from Waste Concern in 2001 but was later discouraged from buying due to the impurities in it. Proshika was producing quick compost for their ecological agriculture programme (Box 8.2).

Another prospective buyer, Nature Farms Products bought compost on one occasion and then discontinued waste derived compost use for concern about contamination of its organic products (Box 8.3).

Table 8.2 : Statement of compost sale in tons

Year	M/S Map- Agro Industries	Proshika	Nature Farm Products	Other sale	Total
2000	15				15
2001	154.34	4.46			158.8
2002	73.3		7	0.85	81.15
2003	60			5	65
2004 (January)				30	30

(Source: Waste Concern 2004)

Box 8.1: Excerpts from interview transcript with Alpha-Agro Ltd.

In an interview with Mr. Rafiqul Islam, Research and Product Manager of Alpha-Agro Ltd he explained that they were experimenting and popularising the product in two districts Bogra (229 km from Dhaka city) and Barisal (277 km from Dhaka city). The customers were their regular chemical fertiliser and pesticide buyers. The goodwill of the company brought the customers. They had not yet disclosed the origin or source of the product to the customers. The dealers were selling on a push sale basis to enable farmers to recognise the product. They were facing problems with the shortage and irregularity of supply and a higher price than the chemical fertilisers that sometimes discouraged the customers from buying compost.

(Source: Field report 2004)

Box 8.2: Excerpts from interview transcript with Proshika.

In an interview with Programme Co-ordinator of Ecological Agriculture programme of Proshika, Afzal Hossain Bhuiyan mentioned that they bought compost from Waste Concern in 2001 and used it in their demonstration plot at their centre in Koitta, Manikgonj. They found pieces of plastic, cloth, glass and other sharp materials in compost that discouraged them from buying waste derived compost again. They were providing training and credit support to their farmers to produce quick compost (oilcake + rice bran or saw dust + cow dung or poultry litter). A good number of farmers were commercially producing quick compost and sold at a price Tk.4 to Tk. 10 per kg and were making a good earning.

(Source: Field report 2003)

Box 8.3: Excerpts from interview transcript with Nature farm Products.

Mr. Hasibur Rahman , Executive Director of ACME laboratories who owns the farm 'Nature Farm Products' near Asulia (15 km from Dhaka) was producing organic fertiliser from poultry litter of his own farm. He bought compost from Waste Concern in 2002 and was no longer interested to use it because of concern about contamination of his vegetables and crops from city solid waste.

(Source: Field report 2003)

In 2004, two fertiliser dealers, one from Mirersarai (190 km from Dhaka) and the other from Fatikchari (280 km from Dhaka) bought compost from Waste Concern. Farmers in those areas used compost as there were no other locally available organic inputs for their agricultural lands. The farmers had two observations: one was the contamination and the other was the high price of compost (Box 8.4).

Box 8.4: Excerpts from interview transcript with compost dealers at Mirershari and Fatikchari.

Interviews with the compost dealers (Md. Nazimuddin of Kamrul traders at Mirersharai and Chowdhury Md. Reazaul Karim of Sonali traders at Fatikchari) revealed that these two areas were hilly and the soils were sandy and there was no other organic fertiliser available in their areas. They heard about Waste Concern compost from television news. They bought compost and sold it to farmers (in Mirersarai 20 farmers and in Fatikchari 16 farmers). The farmers were happy to get compost but they complained about pieces of iron, glass, plastic, needle and tin. The dealers found problems in transporting compost to a long distance, which cost much to the farmers. The compost was comparatively more expensive than chemical fertilisers in their areas and the farmers were asking for a cheaper price.

(Field report 2004)

From the present production and sale of Waste Concern's compost, it was observed that the supply side was not efficient as there was no adequate production of compost to meet the demand or the demand was still uncertain because compost from city waste was not a familiar product and the users had reservations or concerns regarding the contamination of mixed waste compost. Map-Agro was the only prospective buyer of Waste Concern's compost because they had overcome the complaints about contaminants by grinding and blending the raw compost. They had utilised the reputation of the pesticide and fertiliser distribution networks of Alpha-Agro for compost sale.

In Khulna Prism project, the only outlet for the compost was the nurseries. The sale was slow because Prism had not given much attention to sell their compost. It was reflected in the compost production and sale statement of plant-1 (Jan-Sept 2003) that the production of compost was 14560kg and sale was only 3680kg which caused stockpiling of 10880kg (about 75 percent).

Prism recently paid attention to marketing their product widely. It constructed a compost maturation and packaging centre, recruited a marketing officer and established a link with the agriculture extension department (Box 8.5).

Box 8.5: Excerpts from interview transcript with Project Co-ordinator, Prism.

*In an interview with Munir Alam Chowdhury, Project Co-ordinator of Prism, he mentioned that compost must have demand all the time. They were trying to utilise the extension programme of the agriculture department to motivate the farmers to buy their compost. They engaged a marketing officer with an agriculture background who was liaising and arranging meetings with block supervisors, fertiliser dealers and the prospective farmers.
(Field report 2004)*

From the Prism project, it was observed that the demand side was weak, due to poor marketing initiatives. The new marketing idea of Prism by establishing a link with the agriculture extension department and by arranging meetings with the prospective buyers would have a positive impact on compost demand and sale.

In Sylhet, Sylhet Partnership Company was selling compost through a fertiliser and seed distributor Jalalabad Agro Product. The proprietor of the Jalalabad Agro Product gave a piece of land to Sylhet Partnership Company (SPC) for the compost facility and made an agreement with SPC to adjust in return land rent for compost supply. This was a guaranteed purchase arrangement for the compost.

The composting project of Sylhet Partnership Company was a self-sustaining one. It had to cover the operational cost of the project from compost sale. For increasing the sales, Sylhet Partnership offered credit support to farmers and sales incentives to dealers. This aggressive selling gained a favourable response from the farmers and the dealers.

Key points

- Present quantity of compost production in the composting facilities was very insignificant compared to the total waste generation in the cities.
- From mass flow analysis, it has been found that most of the compost facilities were running below the design capacity. This might happen due to the fact that the composting facilities were not designed on the basis of waste generation in the community or because the uncertainty of the compost market discouraged compost production.
- According to Waste Concern's estimate, demand for compost was so high that it could not match requirements with the supply. In the case of Prism, the sale of compost was slow, causing stockpiling of compost. The large sale of compost by Waste Concern was achieved through the established fertiliser and chemical distribution networks of Alpha-Agro. It had overcome the complaints of users about contaminants by grinding and blending the raw compost.
- Prism was creating demand for compost by establishing links with the agriculture extension department.
- Sylhet Partnership Company was trying to increase demand for compost by offering credit support and sales incentives.

Discussion

The present trend of production and consumption of compost indicated that composting resulted in overproduction in the case of Prism and underproduction in the case of Waste Concern. Both overproduction and underproduction are discouraging. Overproduction may cause stockpiling of compost at the cost of money. Underproduction may grow dissatisfaction or discouragement and ultimately tend to lose the potential customer. The community-based composting projects were successful for demonstrating waste reduction and recycling value of waste but failed to create demand for the product or to develop the market. It was found by Furedy and Kulkarni (2004) that NGOs and CBOs operating community composting projects were more interested in experimenting with the composting process rather than exploring markets for the product. Davies et al. (2004) noted that the potential of composting both in production and use was so low that it could not be claimed to be a

part of a waste minimisation programme or a sustainable approach to waste management. At the present state of production and consumption of compost, it would be difficult for the composting projects to sustain their activities by creating demand or developing markets for the product.

Farmers, nurseries, municipalities and landscapers were the potential users of compost (Hart and Plumiers 1996). The next section discusses the perceptions of potential users about the benefits and use of waste-derived compost.

8.3 Knowledge and perception of farmers

Agriculture may be the potential market for compost because the farmers are gradually realising the adverse impact of sole use of chemical fertiliser and the need for organic matter replenishment into their agricultural soil (Box 8.6). Farmers have responded this shortage of organic matter and declining soil fertility by using chemical fertilisers more extensively for better returns.

Box 8.6: Experiences of farmers.

When interviewed with a farmer in Shampur shared his experience that for the first few years, the chemical fertiliser increased their crop production. But then it stabilised and started to fall. After that they were applying more and more fertilisers in the hope of rising production.

Another farmer reported that the intensive use of fertilisers did not substantially raise their crop production but rather made their soil hard and less capable of holding water so they were using manure along with chemical fertilisers. They tried to mix cow-dung and rotten hyacinths which had improved their soil quality.

(Source: Interview during questionnaire survey with farmers 2004)

8.3.1 Farmers who used waste derived compost

Questionnaire surveys were conducted with farmers in Mirershari and Fatikchari areas where waste derived compost was used by the farmers. For comparison, questionnaire surveys were also conducted in peri-urban areas of Dhaka and Khulna city where farmers had no experience with waste-derived compost use (Section 3.7.2.2 of the methodology).

In Mirershari 20 farmers were interviewed. 70 percent of them were cultivating their own lands. 55 percent of the farmers had small (0.2-1.0 hectares) and 25 percent had marginal (0.02-0.2 hectares) farm land holdings.

In Fatikchari 16 farmers were interviewed. 81.3 percent of them were cultivating their own lands. 75 percent of the farmers had small farm landholdings (0.2 -1.0 hectares).

In Fatikchari area, farmers used compost once and in Mirershari farmers used it twice. They bought compost from the local fertiliser dealers. Most of the farmers used compost for the first time and did not get their harvest until the survey period.

In reply to a question

Why are you using compost? (Question 16 of the questionnaire Appendix B4)

most of the farmers expressed their expected benefits of compost use (Table 8.3, Fig 8.2). The farmers responded that they used compost in the hope that it would help to grow more crops, increase soil fertility, soften soil, reduce chemical fertiliser requirement, and produce vegetables which would remain fresh for a longer time.

Benefits	Mirershari (N=20)	Fatikchari (N=16)
Growing more crops	12 (60%)	9 (67%)
Increase soil fertility	16 (80%)	14 (87.5%)
Loosening of soil	17 (85%)	12 (75%)
Less chemical fertiliser requirement	10 (50%)	14 (87.5%)
Less water requirement	2 (10%)	1 (6.25%)
Freshness of vegetables	17 (85%)	8 (50%)
For good taste	2 (10%)	3 (18.75%)

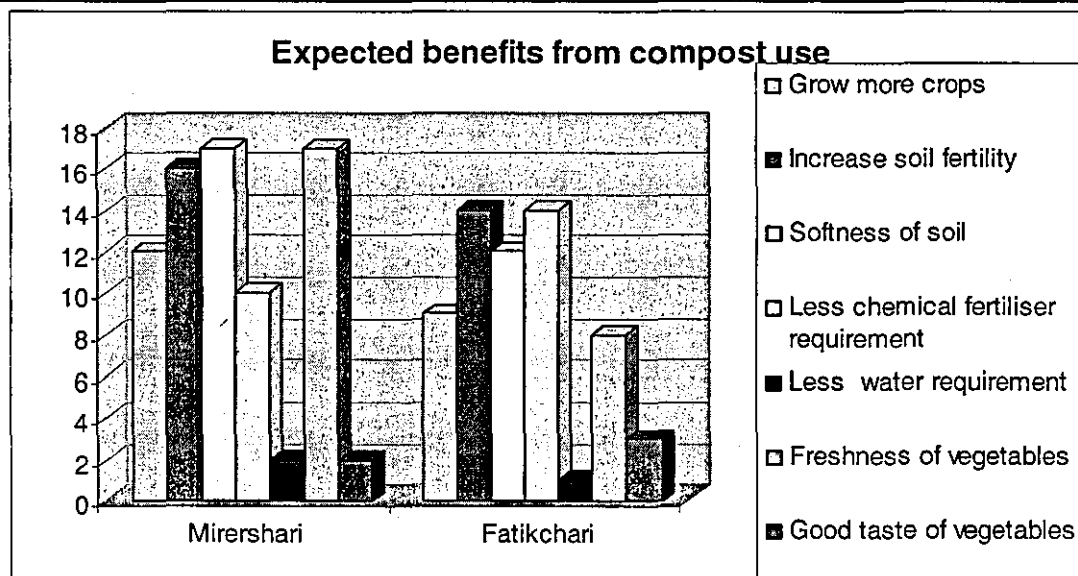


Fig 8.2: Expected benefits of compost use

At this initial stage of compost use, it was difficult to determine the satisfaction level of the farmers. However, two questions were asked (question 17 and 18 of the questionnaire in Appendix B4) to know the problems found in compost by the farmers:

Are you satisfied with compost use?

What are the problems you encounter in compost use?

It was found from the questionnaire survey (Table 8.4) that in Mirershari 80 percent and in Fatikchari 50 percent of the respondent farmers was satisfied with compost use. A cross-tabulation between 'satisfaction level' and 'problems encountered in compost use' showed that Pearson Chi-square both for Mirershari and Fatikchari were not significant at values 0.535 and 0.472 respectively (greater than 0.05). It indicated that though the farmers were satisfied with compost use but they did complain about the contamination with unwanted and sharp materials, slow plant growth and high cost.

Table 8.4 :Cross-tabulation for satisfaction level and problems encountered in compost use				
Satisfaction level	Problems in compost use			Total (%)
	Presence of contaminants	Plant growth is slow	Expenditure is more	
Mirershari				
Yes	9 (56.3,75.0)	4 (25.0)	3 (15.0,75.0)	16(80.0)
No	3(75.0,25.0)		1(25.0,25.0)	4 (20.0)
Total (%)	12(60.0)	4(20.0)	4(20.0)	20(100.0)
Pearson Chi-square	Value 1.250	df 2	Significance 0.535	
Fatikchari				
Yes	5 (62.5,41.7)	2 (25.0,50.0)	1 (12.5,25.0)	8(50.0)
No	3(37.5,25.0)	2(25.0,50.0)	3(37.5,75.0)	8(50.0)
Total (%)	8(50.0)	4(25.0)	4(25.0)	16(100.0)
Pearson Chi-square	Value 1.50	df 2	Significance 0.472	

Despite concerns or problems found in waste derived compost, the farmers in Mirershari were told that they had no alternatives to compost³⁴ use because local sources of organic inputs had diminished considerably over the years (Box 8.7).

³⁴ For clear distinction 'compost' is used for waste derived compost and 'organic fertilisers' is used for locally available organic sources.

Box 8.7: Interview with farmers at Mirershari.

From interviews with farmers at Mirershari, it is noted that the farmers had been using cow-dung for a long time. But it was not easily available to the farmers and was expensive to carry over long distances from the farm. There was a shortage of other organic sources but the farmers badly needed organic matter for their soils. (Source: Interview during questionnaire survey with farmers 2004)

The degree of linear relationship between the variables ‘satisfaction of using compost’ and ‘willingness to pay’ showed that the correlation co-efficients(R) were positive both for Mirershari (R=0.134) and Fatikchari (R=0.378). The positive correlation indicated that the two variables co-varied in the same direction i.e. if the farmers were satisfied with compost use, they would be more willing to pay (Table 8.5).

Table 8.5 Relationship between ‘satisfaction in using compost’ and ‘willingness to pay’

	R	R _{square}	Adjusted R _{square}	Standard error of the estimate
Mirershari	0.134	0.018	-0.037	0.41786
Fatikchari	0.378	.143	0.082	0.49487

From a cross-tabulation of two variables ‘satisfaction of using compost’ and ‘willingness to pay’, it was found that the hypothesis ‘There is likely a relationship between satisfaction over compost use and willingness to pay’ was accepted by the Pearson Chi-square at Mirershari and Fatikchari at significance levels of 0.024 and 0.000 respectively (Table8.6). This indicated that if the farmers were satisfied they would pay more and if they were not satisfied they would not agree to pay even at the present selling price of compost.

Table 8.6 Cross-tabulation of satisfaction level and willingness to pay				
Satisfaction level	Willingness to pay			Total (%)
	Present price	Less than the present price	More than the present price	
Mirershari				
Yes	8(50.0)	4(25.0,50.0)	4(25.0)	16 (80.0)
No		4(100.0,50.0)		4 (20.0)
Total (%)	8(40.0)	8(40.0)	4(20.0)	20(100.0)
Pearson Chi-square	Value 7.5	df 2	Significance 0.024	
Fatikchari				
Yes	6		2	8(50.0)
No		8		8(50.0)
Total (%)	6(37.5)	8(50.0)	2(12.5)	16(100.0)
Pearson Chi-square	Value 16.0	df 2	Significance 0.000	

From this section, it was observed that waste derived compost was newly introduced to the farmers and the farmers had a demand for organic matter in their soils. The farmers had big expectations from the compost of getting more crops, increasing soil fertility and improving soil texture and requiring less chemical fertiliser. At this initial stage of compost use, it was difficult to make a conclusion from the satisfaction and dissatisfaction level of the farmers to measure a real demand for compost. From the statistical significance it could be concluded that if the farmers were satisfied with the compost use they would be willing to pay more.

8.3.2 Farmers in peri-urban areas

Urban and peri-urban areas are the potential markets for compost (Asomani-Boateng and Haight 1999; Drechsel and Kunze 2001). To know the awareness and knowledge level of the farmers in peri-urban areas, questionnaire surveys were conducted in peri-urban areas of Dhaka and Khulna (Section 3.7.2.2 of the methodology). In reply to the questions (question 11 and 12 of the questionnaire of Appendix B5)

- Do you use compost?
- If yes, why you are using compost?

it was found that majority of the urban farmers [in Shampur (80 percent), Munshigonj (85 percent) and Rajbari (65 percent)] were using compost. It needs to be noted that the composts that the farmers had in mind were the locally available organic fertilisers such as farm yard manure, poultry litter, crop residues etc. (Table 8.7).

Organic fertilisers	Shampur (N=20)	Munshigonj (N=20)	Rajbari (N=20)
Cow-dung	16(80 %)	17(85%)	13(65%)
Green-manure ³⁵	2(10 %)	1(5%)	1(5%)
Brown manure ³⁶	8(40 %)	10(50%)	6(30%)
Farm yard manure ³⁷	9(45 %)	12(80%)	10(50%)
Poultry litter	8(40%)	10(50%)	3(15%)

The farmers were using compost because they knew the benefits of the organic fertilisers for improving soil texture and fertility, increasing crop yield and plant growth, and enhancing water retention.

Though the farmers had basic awareness about organic fertiliser use and its benefits, the respondent farmers were unfamiliar with the production and use of urban waste derived compost. The cross-tabulation of the two variables 'Knowledge about waste derived compost' and 'Interest in waste derived compost use' (Table 8.8) showed that the hypothesis 'There is relationship between knowledge and interest in waste derived compost use' was rejected by the Pearson Chi-square test at Shampur, Munshigonj and Rajbari at the significance levels of 0.348, 0.531 and 0.331 respectively (larger than 0.05). It indicated that knowledge about waste derived compost would not influence the farmers in compost use unless they observed its effectiveness and benefits.

³⁵ Green manure is leguminous crops that are grown and ploughed down in soil. Green manure is beneficial as it adds large quantity of nitrogen to the soil besides the organic matter, suppresses weeds and helps soil conservation, reduces the leaching of nutrients. In Bangladesh Dhaincha and cowpea are used for green manuring (BARC 1997).

³⁶ Brown manure is the crop residues retained in the field and incorporated through ploughing in the soil (BARC 1997).

³⁷ Farm yard manure is the decomposed mixture of dung and urine of the farm animals along with bedding material and left over material from fodder fed to the cattle.

Table 8.8 : Cross-tabulation of knowledge about waste derived compost and Interest in compost use			
Knowledge about waste derived compost	Interest in waste derived compost use		Total (%)
	Yes	No	
Shampur			
Yes		4 (100.0,23.5)	4 (20.0)
No	3(18.8)	13(81.2,76.5)	16 (80.0)
Total (%)	3(15.0)	17(85.0)	20(100.0)
Pearson Chi-square	Value	df	Significance
	0.882	1	0.348
Munshigonj			
Yes		3(100.0,16.67)	3(15.0)
No	2(11.76)	15(88.2,83.3)	17(85.0)
Total (%)	2(10.0)	18(90.0)	20(100.0)
Pearson Chi-square	Value	df	Significance
	0.392	1	0.531
Rajbari			
Yes	1(33.3,33.3)	2(66.7,11.8)	3(15.0)
No	2(11.8,66.7)	15	17(85.0)
Total (%)	3(15.0)	17(85.0)	20(100.0)
Pearson Chi-square	Value	df	Significance
	0.930	1	0.335

A further cross-tabulation (Table 8.9) between the two variables 'Interest in waste derived compost' and 'Reasons for unwillingness to use waste derived compost' showed that the Pearson Chi-square test gave significance levels of 0.014, 0.029 and 0.019 (which is less than 0.05) for Shampur, Munshigonj and Rajbari respectively with the majority of the respondent farmers lacking an interest in waste derived compost use. Among the respondent farmers in Shampur 47 percent, in Munshigonj 44.4 percent and in Rajbari 41.2 percent had concerns about the potential pollution of the soil. In Shampur 29.4 percent, in Munshigonj 27.8 percent mentioned that they did not have specific knowledge or have information on the product and its availability. In Shampur 11.8 percent, in Munshigonj 22.2 and in Rajbari 23.5 percent mentioned that they had alternative local organic fertiliser sources. In Shampur 11.8 percent and in Rajbari 29.4 percent lacked confidence in the product effectiveness as a soil conditioner.

Table 8.9 : Reasons for unwillingness to use compost by the peri-urban farmers					
Interest in waste derived compost	Reasons for unwillingness to use waste derived compost				Total (%)
	No knowledge or information	Concern about pollution of soil	Availability of local organic materials	No confidence in the product	
Shampur					
Yes			3(100,60)		3(15.0)
No	5(29.4)	8(47.0)	2(11.8,40)	2(11.8)	17(85.0)
Total (%)	5(25.0)	8(40.0)	5(20.0)	2(10.0)	20(100.0)
Pearson Chi-square	Value 10.588	df 3	Significance 0.014		
Munshigonj					
Yes	1(50,16.7)	1(50,11.1)			2(10.0)
No	5(27.8,83.3)	8(44.4,88.8)	4(22.2)	1(5.6)	18(90.0)
Total (%)	6(30.0)	9(45.0)	4(20.0)	1(5.0)	20(100.0)
Pearson Chi-square	Value 11.987	df 3	Significance 0.029		
Rajbari					
Yes	1(33.3,50)	1(33.3,12.5)		1(33.3,16.7)	3(15.0)
No	1(5.9,50)	7(41.2,87.5)	4(23.5)	5(29.4)(83.3)	17(85.0)
Total (%)	2(10.0)	8(40.0)	4(20.0)	6(30.0)	20(100.0)
Pearson Chi-square	Value 10.953	df 3	Significance 0.019		

Key points

- Farmers had realised the negative effects of sole chemical fertiliser use in crop production and soil degradation. They knew the benefits of organic matter in soil and usually used locally available organic fertiliser sources.
- Waste derived compost was new to the farmers. Farmers used compost with the hope of getting more crops, increasing soil fertility, requiring less chemical fertilisers and producing vegetables which would remain fresh for a longer time.
- Though at the initial stage of compost use, it was difficult to make a conclusion from satisfaction and dissatisfaction levels but from the statistical significance it could be deduced that if the farmers are satisfied with the compost they will be willing to pay more.
- Though the farmers knew the benefits of organic fertilisers but they were unfamiliar with the production and use of urban waste derived compost.
- It was found from statistical significance that the knowledge about waste derived compost might not influence the farmers to use compost unless they observed its effectiveness and benefits.

- Majority of the peri-urban farmers did not have interest in waste derived compost because they had no specific knowledge or information on the product and its availability. They had concerns about potential pollution, there was availability of local organic inputs and a lack of confidence in the product's effectiveness as a soil conditioner.

Discussion

From the surveys and interviews with the farmers it was reflected that the farmers had uncertainty or scepticism about the use of waste derived compost. The scepticism or uncertainty was probably due to lack of knowledge and experience with the product use, and concern about harmful materials in the waste derived compost. With this knowledge and information level, it would be difficult to create a demand for waste derived compost and gain a market in the urban and peri-urban areas which is likely to affect the sustainability of the compost production. Davies et al. (2004) and Somda et al. (2002) also observed that the potential users had little specific knowledge about the benefits of compost in terms of crop yield. Brook and Davila (2000) further confirmed that compost demand was high in India and Africa but due to lack of dissemination of information about the benefits of compost, farmers were reluctant to buy or use compost. They had uncertainty about how it would be valued and priced. Zurbrugg (2003) found in Dar es Salaam Tanzania that theoretically there was a potential large market for compost in urban and peri-urban areas. However, lack of knowledge about compost benefits and practical experiences of the farmers hindered compost demand.

8.4 Perception of nursery owners

The nurseries are the main suppliers of plants for home gardeners, city plantation and greening programmes. They are the important outlets for compost sale in the cities. They usually make and sell compost of their own. In an interview with the Chairman of Bangladesh Nursery Owners' Association, it was found that the nurseries in Dhaka cities were not aware of or had no information about waste derived compost. But they might be the potential compost sale centres (Box 8.8). Like the private nurseries, the government nurseries which produce saplings for government plantation programmes

made their own compost. In the government policy and procurement protocol, there is a provision for buying and making compost from cow-dung. The use of compost in government nurseries largely depends on government procurement policy (Box 8.9).

Box 8.8: Interview with Chairman of Bangladesh Nursery Owners' Association.

According to an interview with M. A. Hakim, Chairman Bangladesh Nursery Owners' Association, there were 200 nurseries around Dhaka city. The nurseries grew seedlings, saplings, and potting plants, and sold potting soil and organic fertilisers. They usually made and sold compost from cow-dung, plant leaves and soil. He heard about compost from city waste from the television news. They were not yet approached to use or sell compost. Some organic fertiliser manufacturers were using nurseries as their selling outlets. Waste derived compost might be popular if it was well demonstrated, of good quality and of cheaper price. (Source: Field survey 2004)

Box 8.9: Interview with Government Arboriculture Inspector.

An interview with Mr. Fazlul Haq, Arboriculture inspector of a government nursery at Savar (40 km away from Dhaka) told that they usually bought 5 to 6 trucks of cow-dung from the government dairy farm at a rate of Tk. 1600-1800 per truck and piled it into layers with soil and kept it for 5 to 6 months. They used it to produce saplings for government plantation programme. It was dependent on government procurement policy and expenditure protocol which types of compost or fertiliser the government nurseries would produce and use for the saplings. (Source: Field survey 2004)

A questionnaire survey was conducted among 20 nurseries around Dhaka city. It was found from the survey that most of the nurseries were using self-made compost. None of the nurseries were using waste derived compost. The nurseries were mainly using cow-dung or sometimes poultry litter to make their own compost. The other organic sources used by the nurseries were bone meal³⁸, burned clay, oil cake³⁹, tea leaf, ash⁴⁰, blood meal⁴¹ etc.

³⁸ Bones of dead animals are crushed or ground into dust and utilised as a good fertiliser. Bone meal is an important source of N and P as it contains 2-5% N and 26-28% phosphate (Tandon, 1995).

³⁹ The solid portion of the oil seeds left after extraction of oil is called oil cake. Oil cakes are generally referred to as concentrated organic manures because of their higher nutrient content. In India the oil cake from neem seeds is used as nitrification inhibitors (Tandon 1995).

⁴⁰ Household ash is the principal organic source of potassium with a potassium content of 2.3-12.3% and lime 20-50% (BARC 1997).

⁴¹ Blood meal is a major slaughter house by-product that contains over 80% protein on dry-matter basis. It contains 10-12% N, 1-2 % P₂O₅ and 1% K₂O and having C/N ratio 3-4 (Tandon, 1995).

A cross-tabulation of two variables ‘ Interest in waste derived compost’ and ‘ Reasons for unwillingness to use waste derived compost’ showed that Pearson Chi-square value is 0.024 (which is lower than 0.05) which indicated that most of the nurseries had no interest in using waste derived compost. About 64.7 percent of respondent nurseries were not interested to use waste derived compost because they had no confidence in the product’s effectiveness on plant growth, 17.6 percent thought that the plants might die and 17.6 percent had concerns that the compost might cause infestations of insects and pests.

Interest to use waste derived compost	Reasons for unwillingness to use waste derived compost					Total (%)
	No confidence on the product	Plant may die	Expensive than self-made compost	Slow plant growth	Infestation of insects and pest	
Yes			2(6.67)	1(3.33)		3(15.0)
No	11(64.7)	3(17.6)			3(17.6)	17(85.0)
Total (%)	11(55.0)	3(15.0)	2(10.0)	1(5.0)	3(15.0)	20(100.0)
Pearson Chi-square	Value 11.273	df 4	Significance 0.024			

In Khulna, Prism used to sell compost through nursery outlets. From an interview with a nursery owner it is found that the customers had reservations about spending money on the compost and they were not confident in the product without first observing its effectiveness on plant growth (Box 8.10).

Box 8.10: Interview with Nursery owner.

In an interview with Abdul Bari of Rangabon nursery, he stated that the sale of compost was very slow. The customers did not want to buy waste derived compost by spending money. They wanted free samples to see the effectiveness of the product on plant growth.

(Source: Field survey 2004)

Key points:

- Nurseries might be the largest potential outlets for compost in urban areas but nurseries were not aware of waste derived compost. They had not yet been utilised as selling points for compost in Dhaka.

- Nurseries were using and selling self-made compost. Government procurement policy made provision for using cow-dung as an organic fertiliser source.
- Nurseries were not confident in the quality and effectiveness of compost on plant growth.

Discussion

Nurseries might be potential users as well as sale centres for compost. Nurseries had not yet been approached to sell compost in Dhaka city. In Khulna, nurseries were utilised as the main selling outlets for compost. But compost could not create demand among the nursery customers because the customers were not confident about the product's effectiveness and they were not sure how the compost would be valued and priced. Nurseries both private and government were making their own compost from tree leaves and cow-dung. Zurbrugg (2003) found in Karachi, Pakistan, that nurseries were fast growing businesses and might be the mainstream users of compost but they did not have any information about the compost.

8.5 Perception of the municipality

In the cities the municipal authorities maintain the flower beds, small gardens and plantations along the city streets. Municipalities could be large potential markets for compost through buy-back arrangements. It was observed from the interviews that compost had not yet received attention of the city authority as an effective organic fertiliser. For introduction into the municipal procurement policy, compost would need to be cheaper, be consistent both in quantity and quality and be effective for plant growth (8.11).

Box 8.11: Interview with Municipal officers.

In an interview with Mehdi Ali Khan, Additional Chief Engineer of Dhaka City Corporation he explained that every year the city corporation spent 6 to 7 million taka for plantation in city parks and gardens under a city beautification programme. They involved contractors for the plantation contract which followed specifications and guidelines. In the city procurement guideline, there was provision for using cow-dung and chemical fertilisers and they arranged the programme according to specified guidelines of the procurement policy.

In another interview with Md. Liakat Ali, Chief Engineer of Khulna City Corporation he explained that endorsement of purchase or use of compost in the municipal procurement policy was difficult for technical and bureaucratic reasons. Procurement policy could endorse those products which were least expensive, most readily available, had consistent properties, was convenient to use and under no public prohibition or objection.

(Source: Field survey 2004)

Key point:

- City procurement policy had no provision for using waste-derived compost in city parks and gardens. Compost had not yet received the attention of the city authority as an effective organic fertiliser.

Discussion

Compost made from municipal solid waste had not yet received attention or priority for municipal procurement when municipalities purchased organic fertilisers for public parks and gardens. This was because municipal authorities were not aware of the nature and characteristics of waste derived compost. Municipal authorities could be potential buyers of compost. Sukuki Exnora has made a buy-back arrangement with the Municipal Corporation of Hyderabad, India through the horticultural department of the state government (Galab et al. 2004).

8.6 Perception of a landscape architect

Compost can be used for a variety of specialist applications in the landscaping sector including top-dressing, turf growing, tree and shrub planting etc. Landscaping might be a large procurement outlet for extensive use of compost. From an interview with a landscape architect, it was found that compost from city waste was not popular in

public and private procurement in Dhaka city. Some large and latent markets existed in the cities but due to lack of publicity and product demonstration those potential markets were not yet captured (Box 8.12).

Box 8.12: Interview with landscape architect.

Dhaka City Beautification Project was the main landscaping work in 2004 with an estimated cost of 100 million taka. The main components of the project were landscaping on city main roads and islands by plantation, greenery, pottery and ancillary works. They used cow-dung as soil-conditioner. In an interview with Mahfuzul Haq Jaglul of Interdec Ltd., the consultant of the project stated that compost had large demand in landscaping and it was sold in the supermarket in many countries. In Bangladesh, compost from city waste was not popular and not widely publicised. (Source: Field survey 2004)

8.7 Factors constraining compost demand and marketing

The previous sections discussed the perception by the potential users of compost which indicates lack of awareness, uncertainty and scepticism among the potential customers of waste derived compost. This is because there was a lack of knowledge and experience with the product, lack of confidence in the product effectiveness and concern about contamination of unwanted materials in mixed waste compost. According to Hoomweg et al. (1999) demand and marketing of compost depends on: (i) condition and fertility of soil (ii) government policies/subsidies on chemical fertilisers (iii) availability and cost of alternatives (iv) agricultural practices (v) reliability and quantity of compost production and (vi) compost quality. This section examines the factors such as agricultural practices and land ownership, product quality and safety, availability and price of alternative products, and legislative, technical and cultural barriers to measuring the demand and marketing of the compost product, which are likely to affect the sustainability and replication of the composting project.

8.7.1 Agricultural practices

There are two agricultural methods or practices that exist in Bangladesh. One is called chemical agriculture which is contributing to high crop yields with the use of

chemical fertilisers, pesticides and other agricultural inputs. The second is still in the experimental stage, organic agriculture involving indigenous techniques, knowledge and materials. Since the 1970s 'Increased food production towards self-sufficiency' has been the major target of the government in this over populated and food deficient country. For the sake of domestic food security, the government welcomed the 'Green Revolution package' which consisted of high yielding variety (HYV) seeds, chemical fertilisers, pesticides, mechanical ploughs and large-scale irrigation. Because of the miracle of the 'HYV' boom in production, the government conducted a massive campaign for promoting chemical agriculture among the farmers. The government provided tax incentives for chemical fertiliser import, loan and credit facilities to farmers, and built fertiliser factories, which indicates government support towards chemical agriculture (Banglapedia 2003).

Awareness is growing in the area of organic fertiliser use in Bangladesh. According to the Bangladesh Agricultural Research Council (BARC 1999), the organic matter of more than half of the cultivated soils in Bangladesh was declining at an alarming rate (below the critical level of 1.5 percent). It occurred due to extensive use of chemical fertilisers without replenishment of the organic matter in the soil. In response to the negative consequences of chemical fertilisers, some NGOs are advocating the use of organic fertilisers (Box 8.13).

Box 8.13: NGOs promoting organic fertilisers

Proshika Manobik Unayan Kendra

Proshika an NGO was promoting ecological agriculture using organic fertiliser to enhance soil's natural productivity. Proshika was not only producing compost by itself, it had also motivated and trained 1200 member farmers to produce and use organic compost. Farmers were producing quick compost (oil cake + rice bran or saw dust + cow-dung or poultry litter) in their lands for crop cultivation. For promoting the organic product, Proshika had established organic product selling centres in cities.

UBINIG

UBINIG, an NGO for the organic movement, involved and organised 20,000 farmers for substituting chemical fertilisers with compost. The farmers were motivated to produce compost from water hyacinth. This was a breakthrough as the farmers became aware of the adverse impact of chemical agricultural inputs.

BRAC (Bangladesh Rural Advancement Committee)

BRAC, a large NGO, was promoting organic agriculture by using compost from cow-dung and oil cake in its horticulture research centres.

Source: Field survey, 2003

In Bangladesh, organic agriculture is at an experimental stage and slowly gaining acceptance of the farmers. The farmers have been producing compost for their own consumption from locally available materials. In the peri-urban areas of Dhaka, the farmers were using cow-dung and poultry litter (Box 8.14). It was found from the survey in peri-urban areas that production and use of compost from urban waste sources was unfamiliar to the farmers (Section 8.3.2). Against this backdrop, there would be difficulty in creating demand for urban waste compost amongst the farmers.

Box 8.14: Interview with a peri-urban farmer at Shampur, Dhaka.

During a field survey at Shampur, one farmer said that he used cow-dung and poultry litter as organic inputs in his cultivation. He kept cow-dung from his farm in a pit in the rainy season for three to four months for decomposition and used it for the winter vegetable growing. He also said that recently poultry litter is becoming very popular among the farmers and he bought it at Tk. 1800-2000 per truck from the nearby farms.

(Source: Field survey 2004)

8.7.1.1 Problems associated with agriculture practices and compost use

The availability of credit or fiscal incentive for chemical fertilisers was also critical for developing a market for waste derived compost. Farmers were getting chemical fertilisers on credit from fertiliser dealers or they had access to agriculture loans at a low interest rate from banks. This was an added incentive as well as support to the poor farmers. Small-scale composting facilities largely depend on the income from compost sale to pay the salaries of the workers. If the small compost manufacturers were to sell their products on credit, they might not sustain their activities.

Another constraint to compost in the agricultural practices was its seasonal sale, mainly in the winter (Rabi⁴²) season. Large stocks of compost were needed for the cropping season that might prevent money from reaching the small compost manufacturers.

In Bangladesh, the agricultural technologies or practices were transferred to farmers through extension officials (block supervisors). The farmers were well connected to block supervisors who usually advised them about the techniques and practices of

⁴² There are three agriculture seasons in Bangladesh. Rabi (November-February), Kharif-1 (March-June) and Kharif-2 (July – October).

cultivation. Block supervisors used to have good understanding of the needs of the farmers. They kept some plots for field demonstration of agricultural inputs. Agriculture extension department through block supervisors was a big avenue to create compost demand which was unaddressed by the compost manufacturers.

In Khulna, Prism had been trying to market its compost by establishing links with the agriculture extension department. It opened a good opportunity for compost to reach the farmers and thus increase its sale.

Key points

- Government provided tax incentives to chemical fertiliser import, eased loan and credit facilities, and built chemical fertiliser factories to encourage chemical agriculture for growing more foods.
- Small-scale compost manufacturers could hardly survive or sustain their activities if they used to sell their compost on credit.
- Due to extensive use of chemical fertilisers and non-replenishment of organic inputs, organic matter had been declining in soil at an alarming rate. Some NGOs were advocating organic fertiliser use or organic farming. But it was limited to locally available cheap organic inputs like cow-dung, poultry litter etc.
- Compost demand was seasonal mainly in winter cultivation, which needed to stock larger amount of compost for the season. It might hamper the cash flow of the small compost manufacturers who largely depended on compost sale to pay salaries of the workers.
- Agriculture extension department was a big avenue to create compost demand among the farmers but compost from city waste was poorly linked with agriculture sector.

Discussion

The readily available chemical fertiliser in the market, and government promotion and subsidies to chemical agriculture makes it difficult to popularise compost use among the farmers. Peters (1998) and Davies et al. (2004) had the same opinion that the availability of credit and fiscal incentives for chemical fertilisers was critical for the efforts to create compost demand and thus affecting the sustainability of the

composting projects. A degree of government support is essential for the promotion and marketing of compost. The Ministry of Agriculture may be the mainstay for promoting compost but unfortunately composting activity was rarely linked with the agriculture department (Dulac 2001).

8.7.2 Land ownership

Historically, Bangladesh has been acclaimed the 'Land of Gold' due to its affluence and richness of soil fertility. The lands were managed through communal village systems, where the farmers tilled and cultivated lands hereditarily. The traditional communal system of land management underwent significant changes during the Mughal rule and British colonialisation which created zamindars (landlords). The zamindar had the right to collect tax from the farmers and had power to transfer lands freely in the form of sale, gift, lease and so on. As a consequence, land ownership patterns shifted towards those with high social status and the powerful classes. The poor farmers who had traditionally enjoyed the hereditary rights over the land suddenly became landless (Banglapedia 2003). According to the 1996 Agriculture Census of Bangladesh, the majority of the farmers (about 76 percent) were either landless or owned small holdings of below 1 hectare (Table 8.11).

Classification of landholds by size	Category in percentage
Landless households (operating below 0.02 ha)	20
Marginal farm household (operating between 0.02-0.2 ha)	19
Small farm households (operating between 0.2-1.0 ha)	37
Medium farm households (operating between 1.0-3.0 ha)	20
Large farm households (operating above 3.0 ha)	4

Source: Agriculture Census of Bangladesh 1996

The majority of farmers in Bangladesh were sharecroppers or worked on the land as labourers for large landowners. According to the tenancy arrangement sharecroppers cultivated the land of other people and got only half of the produce, the other half being enjoyed by the landowners, although they did not share the cost of irrigation and fertiliser. Another prevailing tenancy arrangement was to take land on a lease

basis for cultivation at a fixed rent. About 20 percent of agricultural lands⁴³ were owned and operated by landholders themselves, 25 percent were rented and 54 percent were for shared cropping (Agriculture Census of Bangladesh 1996). In this land tenure arrangement the rented and shared croppers did not have any incentive to think of the long-term sustainability of the land productivity. They were more inclined to chemical agriculture for a quick return of their investment.

In two peri-urban areas near Dhaka in Shampur and Munshigonj, 65 percent and 60 percent respectively of the respondent farmers were cultivating their own lands. In a cross-tabulation between landownership pattern and interest in using organic fertiliser and waste derived compost (Table 8.12 and 8.13), it was found that in the case of organic fertiliser the Pearson Chi-square values were significant 0.007 and .001 (lower than 0.05) and for waste derived compost the Pearson Chi-square values were not significant at values 0.473 and 0.477 (larger than 0.05). This indicated that farm owners who cultivated their own lands were interested in using organic fertilisers to keep their lands fertile. However, they were not interested in using waste derived compost. It was also found that shared or rented croppers were neither interested in using organic fertiliser nor waste derived compost.

Table 8.12: Cross-tabulation of landownership and Interest in using organic fertiliser			
Land ownership	Interest in using organic fertiliser		Total (%)
	Yes	No	
Shampur			
Self	11(84.6,91.7)	2(15.4,25.0)	13(65.0)
Shared	1(25.0,8.3)	3(75.0,37.5)	4(20.0)
Rented		3(100.0,37.5)	3(15.0)
Total (%)	12(60.0)	8(40.0)	20(100.0)
Pearson Chi-square	Value 9.824	df 2	Significance 0.007
Munshigonj			
Self	10(83.3,100.0)	2(16.7,20.0)	12(60.0)
Shared		3(100.0,30.0)	3(15.0)
Rented		5(100.0,50.0)	5(25.0)
Total (%)	10(50.0)	10(50.0)	20(100.0)
Pearson Chi-square	Value 13.333	df 2	Significance 0.001

⁴³ Bangladesh has a total land surface of 12.31 million hectares, of which 7.85 million hectares are under agriculture.

Table 8.13: Cross-tabulation for landownership and Interest in using waste derived compost			
Land ownership	Interest in using waste derived compost		Total (%)
	Yes	No	
Shampur			
Self	2(15.4,66.7)	11(84.6,64.7)	13(65.0)
Shared		4(100.0,23.5)	4(20.0)
Rented	1(33.3,33.3)	2(66.7,11.7)	3(15.0)
Total (%)	3(15.0)	17(85.0)	20(100.0)
Pearson Chi-square	Value 1.498	df 2	Significance 0.473
Munshigonj			
Self	2(16.7,100.0)	10(83.3,55.5)	12(60.0)
Shared		3(100.0,16.7)	3(15.0)
Rented		5(100.0,27.8)	5(25.0)
Total (%)	2(10.0)	18(50.0)	20(100.0)
Pearson Chi-square	Value 1.481	df 2	Significance 0.477

About 70 percent of the farmers at Shampur and Munshigonj had small and marginal landholdings of less than 1 hectare. From the cross-tabulation of two variables, farmers' category and interest in using waste derived compost (Table 8.14), it was found that the hypothesis 'There is likely to be a relationship between the farmers category and interest in using waste derived compost' was rejected by Pearson chi-square test at Shampur and Munshigonj as the significance levels are 0.593 and 0.071 (larger than 0.05). The majority of the respondent farmers had small lands. They did not show interest because they had little scope to test the effectiveness of the product in their small pieces of land.

Table 8.14 : Cross-tabulation for farmers category and interest in using waste derived compost				
Farmers category	Interest to use waste derived compost			
	Shampur		Munshigonj	
	Yes	No	Yes	No
Marginal farm land holds		1		3
Small farm land holds	2	14		12
Medium farm land holds	1	2	1	2
Large farm land holds			1	1
Total	3	17	2	18
Pearson Chi-square	Value 1.046 df 2 Significance 0.593		Value 7.037 df 3 Significance 0.071	

Key points

- Small land hold farmers did not have any incentive to use organic fertiliser for its long-term sustainability of land productivity.
- Farmers who owned lands were using organic fertilisers to keep their lands fertile. However, they were not interested in using waste derived compost.
- Shared or rented croppers were neither interested in using organic fertiliser nor in waste derived compost. They were more inclined to chemical agriculture for a quick return on their investment.

Discussion

Farmers' soil fertility management practices are closely related to land tenure and ownership. Chuma et al. (2000) and Campbell et al. (1997) reported that land availability and farmers wealth affected the adoption of composting. Brook and Davila (2000) found the same observation in a study in India and Africa that the land tenure system was an influencing factor on whether the farmers buy and use compost. It can be concluded from the section that landownership is an important issue for influencing the farmers' decision to use organic fertiliser in their lands. Farmers who cultivate their own lands or who own large land holds usually prefer organic fertiliser use in their lands. Shared or rented croppers or small land hold farmers are inclined to use chemical fertilisers to get more crops. However, farmers' choice for waste derived compost is still uncertain.

8.7.3 Product quality and safety

Quality is important in creating a demand and achieving a market for compost. It is a good basis for sales promotion, for public relations and for building up confidence (Barth 2001). Compost quality defined by Hart and Plumers (1996) was that compost should be fully decomposed, should be clean, pathogen free and absence of obnoxious odour. Compost quality in this research is defined as compost that should be free from both physical and chemical contaminants and thus acceptable to the end-users i.e. if the quality of compost is improved, the end-users will gain confidence to buy it. The compost product made from mixed solid waste may be contaminated by glass pieces, sharp objects, plastics, medical contaminants and heavy metals. The inert

contaminants such as glass fragments and plastic pieces may affect the visual appearance and discourage the users. The resolution of this problem requires an extra effort.

In surveys at Mirershari and Fatikchari 60% and 50% respectively of respondent farmers lodged complaints about the presence of contaminants in the Waste Concern compost (Table 8.4). To provide quality compost for the users, Waste Concern usually sold raw compost to Map Agro, who subsequently processed and removed the physical contaminants by shredding glass materials, picking up metals and removing polythene through a milling machine.

Potential contamination with heavy metals is another issue which may affect the safety of the product. Heavy metal contamination may be caused by discarded household items such as batteries (Hg, Cd, Zn), bulbs (Hg), paints (Cr, Pb, Cd), and used medicines (Hoornweg et al. 1999). The farmers did not have much idea about heavy metal contamination but they had general concerns about pollutants in urban solid waste derived compost. Compost made from urban solid waste has the potential to contaminate soil by heavy metals which therefore have a chance to enter the food chain. In a study conducted in Tanzania, Kassenga (1999) found that the farmers sales were jeopardized by the fear of contamination of vegetables produced from compost. It was confirmed by Rouse (2004) that the farmers who produced organic food and wanted to sell the product in the organic market needed organic certification. For selling the product in the organic market, it is necessary to test for trace elements and heavy metals. It is difficult to get waste derived compost free from heavy metal contamination. The small compost manufacturers did not perform heavy metal tests on their compost (Table 8.15) as they did not have the capacity or support (financial or laboratory facility) to carry out routine heavy metal tests.

Table 8.15 : Test results of compost			
Compost contents ,	Waste Concern compost	Khulna Prism project	Sylhet Partnership company project
N(Nitrogen)	2.28	1.75	1.00
P(Phosphorus)	1.87	1.00	0.50
K(Potassium)	2.17	2.27	0.50
S(Sulfur)	0.68	0.60	0.37
Zn(Zinc)	0.073	0.03	0.04
B(Boron)	0.08	0.10	0.05
OM(Organic Matter)	34.07	11.39	
Ca(Calcium)		4.10	
Fe(Iron)		0.18	
Cu(Copper)		0.02	

(Source: Test results of compost, Waste Concern (2002), Prism (2003), Sylhet Partnership (2003))

Key Points

- Compost produced from mixed solid waste might have chances to be contaminated by physical as well as chemical contaminants. Small-scale compost producers did not have the capacity or facility (financial or laboratory) to carry out tests for heavy metals or trace elements.
- For selling the product in the organic market, it needs to have organic certification. The product should therefore be free from heavy metal and trace element contamination.

Discussion

Solid waste compost has a negative image in terms of pollutants. Most of the compost facilities failed in both developed and developing countries due to poor quality compost produced from mixed waste. Furedy and Kulkarni (2004) pointed out that compost products made from city wastes have been of poor quality due to poor management in preventing contamination. Compost quality and safety are essential to get a market demand for the product. In a survey at Dar es Salaam, Tanzania all the respondents were willing to try out and switch to compost if they could be assured of safety of the compost (Mbuligwe et al. 2002). At this stage all the composting facilities in Bangladesh were producing compost from mixed solid waste. It might have chances to be contaminated by both inert and chemical pollutants. From the field survey, it was reported that farmers complained about the presence of contaminants in compost. This may discourage the farmers from using such compost and thus affect the sale and consequently the sustainability of the composting projects. This was supported by a study in Bangkok; Kim (1995) found that composting projects found difficulty in sustaining operation because low quality waste derived compost has a limited demand.

8.7.4 Availability and price of the alternative product

This section describes the accessibility of compost to potential users, alternatives to compost available to farmers and the cost of those alternatives from chemical fertilisers to other organic inputs. It is evident from the section (8.2) that in Bangladesh, compost was produced in a very insignificant quantity by small initiatives and the potential users were unfamiliar with waste-derived compost.

Traditionally, farmers were practising both crop cultivation and animal husbandry. They were well aware of the value of organic matter which they could usually get from cow dung. Nurseries, which might be the main outlets of compost, preferred to make compost by themselves from locally available organic materials. Most farmers owned livestock which allowed them to collect manure for their crop fields. Poultry litter was becoming a high-demand product to the peri-urban farmers for its low cost and easy availability. Large numbers of poultry farms had been established around the urban areas. Cow-dung and poultry litter were the main sources of raw material for organic fertiliser manufacturers (Box 8.15).

Box 8.15: Organic fertiliser manufacturers

Company name	Faruk Fertiliser Limited
Product	Nutrient enriched organic fertiliser from poultry litter Brand name: Chook Chook Product variety : 7 product designed according to Fertiliser Recommendation Guideline for betel leaf, root and tuber crops, rice, sugar cane, pot and garden plants , banana and vegetables
Location of the facility	Kaliakoir (40 km away from Dhaka city)
Price	Tk. 40/kg
Production capacity and sale	Production capacity 1200 ton/year, sale : 600 ton/year
Nutrient content	N-7.8%, P-8.45 %, K- 3.75 %, OM 25.36 %
Package	2 and 12 kg bag, information inscription of ingredients, nutrient value, benefits, application dose and procedures
Distribution	250 chemical fertiliser dealers in 46 districts, nursery retailers
Promotion	Free samples, advertisement in newspaper, poster, leaflets

Company name	Aftab Fertilisers and Chemical Limited
Product	Nutrient enriched organic fertiliser from poultry litter Brand name: Power super organic fertiliser Product variety : For rice and potato
Location of the facility	Bazitpur (180 km away from Dhaka city)
Price	Tk. 15/kg
Production capacity and sale	Production capacity 200 ton/year, sale : 200 ton/year
Nutrient content	N-8%, P-20 %, K-14 %, S- 5% OM 40 %
Package	1/2 and 1 kg bag, information inscription of ingredients, nutrient value, benefits, application dose and procedures
Distribution	Own pesticide distribution channel
Promotion	Dealer incentives, advertisement in local newspaper and magazines, leaflets

Company name	Bangladesh Environmental Products and Management Limited
Product	Nutrient enriched organic fertiliser from a mixture of cow-dung, bone meal, dry blood Brand name: Susoma organic fertiliser Product variety : For rice, fruits and orchard
Location of the facility	Savar (20 km away from Dhaka city)
Price	Tk. 25/kg
Production capacity and sale	Production capacity 100 ton/year, sale : 100 ton/year
Nutrient content	N-8%, P-6 %, K-4 %, OM 30%
Package	15 kg bag, information inscription of ingredients, nutrient value, benefits, application dose and procedures
Distribution	Fertiliser dealers
Promotion	Demonstration plots at Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI), leaflets

Source: Field survey 2003

From Box (8.15) it can be observed that the organic fertiliser factories were around Dhaka city. Poultry litter and cow-dung were the raw material sources for organic

fertiliser production. The organic fertilisers were mostly blended with chemical fertilisers to balance nutrients and to make the product acceptable to the end-users.

The compost production from both solid waste and other organic sources was small in quantity and the market for the product had not yet developed. At this stage it was difficult to measure whether the products were competitive to each other in terms of availability and price.

Waste Concern made an arrangement with Map-Agro to sell its raw compost at Tk. 2.5/kg. Map Agro processed it and sold it to Alpha Agro Ltd. at Tk.10/kg. Alpha Agro utilised its fertiliser and pesticide distributors and dealers to sell the blended compost. The transportation cost and the margin of profit of the sales network members (Distributor-dealers-agents) had increased the compost price from Tk 2.5/kg to Tk. 15/ kg. Waste Concern did not fix any limit to pricing the product at the retail end of the market nor had control over the product distributor who increased the price by 500 percent.

It was recorded from the local market that the farmers were buying cow-dung or poultry litter at Tk.0.50/kg and chemical fertiliser, especially urea⁴⁴, at Tk.6.50/kg. In Mirershari and Fatikchari area, Waste Concern's compost was sold at Tk.7/kg to Tk.8/kg to the local farmers. A sensitivity analysis was done on the price that the farmers were willing to pay and quantity of compost needed by the farmers at Mirershari and Fatikchari area (Table 8.16). In the demand curve, the price is elastic if the price elasticity

$$\left\{ E_D = \frac{\Delta Q}{(Q_1 + Q_2)/2} \div \frac{\Delta P}{(P_1 + P_2)/2} > 1 \right\}$$

It was found from the sensitivity analysis that if the waste derived compost could satisfy the requirements of the farmers, most of the quantity of compost produced might be sold at a price of Tk. 7/kg at Mirershari and Tk.8/kg at Fatikchari. But it would not be competitive with locally available organic fertilisers in terms of price.

⁴⁴ Urea is a nitrogen (N) source fertiliser. Nitrogen alone is 75 % of the total nutrients used in agriculture, while the use of P and K is limited to about 6.0% and 6.6% (1: 0.12: 0.13)(Karim et al. (1994)).

Table 8.16: Sensitivity analysis of price and quantity of waste derived compost			
Price of willingness to pay (Tk./kg)	Quantity to be needed (ton/year)		Cumulative quantity to be needed (ton/year)
	No. of farmers	Total quantity	
3.00	1	0.50	0.50
4.00	2	0.30+0.50=0.80	1.30
5.00	4	0.20+0.20+0.25+0.30=0.95	2.25
6.00	1	0.45	2.70
7.00	8	0.20+0.30+0.30+0.35+0.40+0.50+1.20+3.00= 6.25	8.95
8.00	2	0.10+1.10=1.20	10.15
9.00	2	0.15+0.30=0.45	10.60
Total	20	$E_D = 1.82 > 1$ (The price elasticity of waste derived compost at Mirershari was elastic (sensitive to price)	
3.00	2	0.50+1.00	1.50
4.00	2	0.30+0.50=0.80	2.30
5.00	2	0.20+0.30=0.50	2.80
6.00	1	0.50	3.30
7.00	1	0.10	3.40
8.00	6	0.15+0.15+0.30+0.40+0.50+0.70=2.20	5.60
9.00	1	0.50	6.10
10.00	1	0.15	6.25
Total	16	$E_D = 1.14 > 1$ (The price elasticity of waste derived compost at Fatikchari was elastic (sensitive to price)	

Key points

- Most farmers in the peri-urban areas had their own livestock which allowed them to make compost by themselves.
- Poultry farms were growing around the cities and poultry litter was gradually becoming a high demand product for the farmers due to its low cost and easy availability.
- The compost production from solid waste and other organic sources was small in quantity. The market for the product had not yet developed. At this stage it was difficult to measure whether the products were competitive to each other in terms of availability and price.
- The compost sale through the established fertiliser or pesticide distribution company had increased but profit margin was added to network members (Distributor-Dealer-Agent) which increased the compost price many times and made it less attractive to potential customers.

- Compost demand was sensitive to price. If the waste derived compost could satisfy the requirements of the farmers, most of the quantity of compost produced might be sold at the present price. But it would not be competitive in terms of price with locally available organic fertilisers which were readily available and cheaper.

Discussion

From this section, it was found that compost had a higher price than both the chemical fertilisers and other locally available organic fertilisers. Farmers preferred to use cow-dung and poultry litter which was readily available and cheaper. Dreshsel and Kunze (2001) mentioned that in Ghana Africa, farmers had high willingness to use and pay for compost because it was less expensive compared to chemical fertilisers; also the farmers found that chemical fertilisers caused skin irritation at the time of application. Due to higher price and small quantity production compost could not compete or maintain demand with the locally available organic fertilisers. Some companies were producing and promoting organic fertilisers based mainly on cow-dung and poultry litter. The products had not yet created demand or developed a market. At this stage of market development, compost could not compete with other organic fertilisers or with the chemical fertiliser in terms of price and availability.

8.7.5 Legislative, technical and cultural barriers

The general limitation of compost demand and marketing was evident from the knowledge and perception of the potential users that compost from city waste was mostly unknown to them. They had a lack of confidence in the product's effectiveness and had concerns about potential pollution (section 8.4). This section discusses the constraints of compost demand and marketing in terms of legislative, technical and cultural limitations. These issues have already been explained in different parts of this chapter. This section will summarise the issues in particular.

The agriculture of Bangladesh has been guided by the National Agriculture Policy 1999. The overall objective of the policy was to attain self-reliance in crop production. For achieving the self-sufficiency in food production, the government was promoting chemical agriculture by providing tax incentives to chemical fertiliser

importers and credit support and soft loans to farmers to buy chemical fertilisers. This put a constraint on the small-scale compost manufacturers that if the compost would have to be sold on credit, the compost projects might not be sustained.

The Agriculture Extension Department might be the key avenue to promote compost and create its demand to the farmers. Due to poor integration with the agricultural sector, the marketing and promotional scope of this department were not utilised for compost sale.

Compost would find difficulty in being accepted for agricultural use under the prevailing bureaucratic system. To get the recommendation of the product for agricultural use, it had to pass through a bureaucratic procedure of the National Fertiliser Standardization Committee and Technical sub-committee which usually took more than two years. It also required an enlistment of the Bangladesh Fertiliser Association which was dominated by chemical fertiliser importers (Interview with Faruk Fertiliser Limited, 2003). In this legislative and institutional arrangement, compost could hardly create a demand or gain a position in the fertiliser market.

Waste Concern sold compost in rural areas through the fertiliser dealers or distributors of Alpha-Agro Ltd. Compost was bulky and the long delivery distance involved transportation costs which added to the market price of the compost. This made compost expensive and unattractive to the farmers.

Another technical limitation of compost was the possibility of both physical and chemical contamination. Waste Concern through Map Agro removed the physical contaminants by shredding glass materials, picking up metals and removing polythene by a milling machine. This was a costly installation for the small-scale manufacturer and such expenditure added to the price of compost. The chemical contamination by heavy metals was another issue which might affect the safety of the product. Routine testing for heavy metals or trace elements was needed for compost as it was produced from mixed waste. Small compost manufacturers had the limitation or lack of capacity (financial or laboratory facility) to perform routine heavy metal tests for compost. There was no wide market for organic products in Bangladesh. The products had to sell on the international market which required organic certification. It is obvious that for the international organic market, the product must be free from heavy metals or trace elements.

Solid waste compost had a negative image of containing pollutants and impurities. A psychological barrier in the minds of the farmers about the possibility of crop contamination by toxic materials from the compost might detract from the demand for waste derived compost.

Key Points

- Agriculture policy of government was supportive to chemical agriculture to bring self-sufficiency in food production. Government provided tax incentives to chemical fertiliser importers and credit support or loan facility to farmers to use chemical fertilisers.
- In the present bureaucratic system to get recommendation for compost use in agriculture and for marketing was a long drawn out exercise.
- There was a lack of knowledge and awareness of the potential users about compost. Users had the perception that compost contained pollutants and impurities.
- Compost from mixed waste had the possibility of both physical and chemical contamination. To remove the contaminants, and for the routine testing for heavy metal contamination, financial involvement is needed for the small compost manufacturers.
- Compost market was rural; it had to transport a long distance which made compost comparatively expensive and unattractive to farmers.
- Compost had poor integration with the agriculture department which might affect the promotion and sale of compost.

Discussion

The use of chemical fertilisers was highly promoted by the government. Farmers could get chemical fertilisers on credit which might affect the natural demand for compost and viability of composting as a revenue generating and self-sustaining activity. Peters (1998) pointed out that availability of credit and fiscal incentives for chemical fertiliser were critical for creating compost demand. Compost demand had not been created due to a lack of knowledge and experience of the potential users. In urban and peri-urban areas, farmers usually used cheaper organic inputs such as cow-dung, poultry litter etc. Compost needed to be transported a long distance to the rural

farmers. Haulage cost and dealer profit margins had increased the price many fold from the manufacturing price which might affect the natural demand for compost from the farmers. Moreover, compost from city waste had a negative image of being polluted by impurities and germs. The legislative, technical and cultural barriers had made the compost unattractive to the potential users and decreased its potential demand and sale. Drechsel and Kunze (2001) found farmers' concerns and constraints in using urban waste derived composts are more likely to be economic or technical than cultural. Because farmers of Ghana had long experience with co-compost from night soil they had knowledge about the expected long-term benefits of compost. In Bangladesh, compost was poorly linked with agriculture sector. Dulac (2001) stressed the importance of government support and links, especially with the agriculture community, for sustainable production and marketing of compost.

8.8 Marketing strategies

The previous section discussed the factors constraining the demand and marketing of compost. It was found from the discussion that awareness of the potential users, product availability and affordable price were the important factors for increasing compost demand and sale. This needs a proper marketing strategy of the product. This section discusses marketing strategies of compost through delivery (transport and distribution) and promotion. Delivery means that the product reaches the customer at the right place at the right time. It may be done by direct sale from the manufacturer, by selling the product through a sales network involving wholesaler and dealers or from a retailer outlet. In this research context delivery refers to availability of the product to the end-users at a right price. Promotion of the product means telling the customers about the benefits of the product, building awareness and encouraging them to buy the product. It can be done through some marketing techniques such as public relations, brand name, attractive packaging, producing variety of product etc. In this research context, promotion refers to informing and demonstrating the benefits of compost for increasing awareness and acceptance of the product by the end-users in order to sustain sales.

In Dhaka, Waste Concern utilised the marketing network of a specialised fertiliser and pesticide distribution company Alpha-Agro. Waste Concern made an agreement with

Map-Agro to buy raw compost from the plant. Map-Agro improved the quality of the raw compost by removing the physical contaminants and grinding it into smaller sizes. They then blended the compost with chemical fertiliser to increase its nutrient balance and made it attractive to the end-users. Map-Agro sold the blended compost to Alpha-Agro, who used its fertiliser distribution network and reputation to sell the product (Fig 8.3). Profit margins were shared among the network members from distributor to retailers.

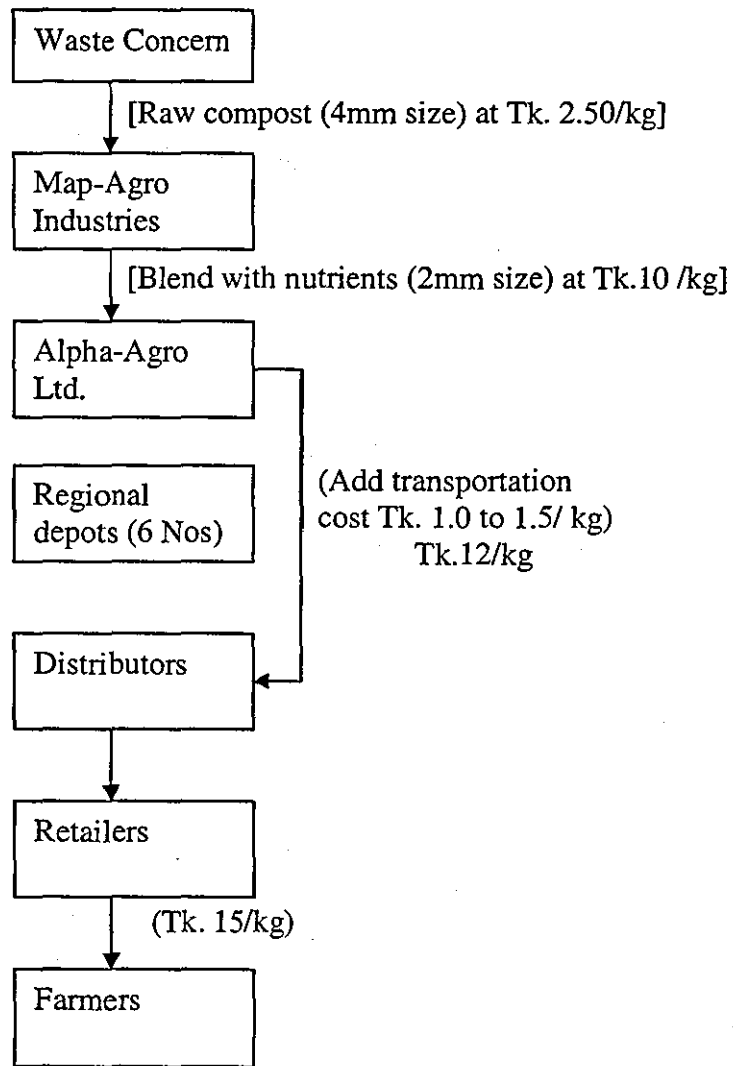


Fig 8.3 Distribution and marketing network of compost

Alpha-Agro was a large fertiliser and pesticide distribution company having sale centres in 64 districts. It only utilised two marketing depots at Bogra (229 km) and Barisal (277 km) districts for experimenting and popularising the compost among the

farmers. Alpha-Agro added transportation cost on an average Tk 1.2/kg which allowed them to sell compost at the same price throughout the country.

For promoting compost Alpha-Agro involved marketing officers who usually communicated the product benefits and utility to the farmers through leaflets and verbal discussion. The product was branded as diamond organic fertiliser and sold in 40 kg bags. The distributors or retailers usually sold the product to the farmers on a 'push sale' basis. According to the Research and Product Manager of Alpha-Agro, the product was difficult to sell due to its high price and irregular supply.

Waste Concern also sold raw compost to fertiliser dealers at Mirershari (190 km) and Fatikchari (280km). At Mirershari, the dealer used to sell the compost at a price of Tk. 7/kg and in Fatikchari at Tk. 8/kg. The fertiliser dealers identified transportation costs⁴⁵ as one of the problems which fixed the selling price comparatively higher than the chemical fertilisers.

In Khulna, Prism found difficulty in selling compost. They sold compost through nursery outlets which was very slow. Prism started selling compost by establishing links with the agriculture extension department. Marketing through the agriculture extension department helped to increase the awareness and acceptance of the product to the farmers. Other problems with the Prism compost were the lack of demonstration areas and the improper packaging of the compost. It was not properly presented with nutrition content and application dose. Packaging can enhance a product image and appeal, and give customers confidence and trust. From an interview with Abdul Bari of Rangabon nursery, it was found that the sale of compost was very slow. The customers did not want to buy compost from waste by spending money. They were not getting confidence in the product without observing its effectiveness on plant growth. For creating demand for the new product, free samples might be needed to supply to the customers as a promotional technique. The customers would not gain confidence in the waste derived compost unless it was tested. If the customers would find benefits in using the product, the demand could automatically be created through word of mouth communication (Dulac 2001). This could save promotional expenses as well. Prism was selling compost under the brand

⁴⁵ Transport cost for goods in Bangladesh for first 100 km was Tk.4000 /truck and for every additional 100 km Tk.1000.

name Sabuz Sona (Green Gold). An appealing name may also create a positive image or sense of the product (Segall and Alpert 1990).

In Sylhet, the Sylhet partnership company introduced credit support to farmers and sales incentives for the dealers. This aggressive marketing increased the sale of the compost. The Karnataka Compost Development Corporation (KCDC) of India used to sell enriched compost through the department of Agriculture with subsidies of 2 months credit and a dealer margin of 10-15 percent (Zurbrugg 2002). This was possible for a big company with large production and sale. For small-scale compost manufacturers, the delayed pay back might affect cash flow as well as production.

Key points

- Compost sale through established marketing networks was effective and reliable but the margin of profit shared among the network members increased the price of compost.
- Long distance delivery involved huge expenditure on transport which added to the market price of compost making it unattractive and unaffordable to end-users.
- Establishing links with the agriculture extension department for sales promotion was effective for increasing awareness, acceptance and demand for compost amongst the farmers.
- The most effective marketing promotional tool is to make provision of free compost for experiment and demonstration purposes.
- Credit support to farmers and sales incentives to dealers were effective for aggressive marketing but would be risky for small-scale compost manufacturers.

Discussion

Compost price must be competitive with other organic fertilisers as well as with chemical fertilisers. For transporting compost to a point of sale, the main problem experienced is the low value and bulky nature of the compost which makes the transportation cost too high (Dreschel and Kunze 2001). In most cases, the price is beyond the purchasing capacity of the potential customers and makes compost

unattractive. The established fertiliser or pesticide distribution company could be an effective channel for marketing compost as they have good links with farmers as well as the agriculture department (Coad 1996). Perla (1997) emphasised the importance of growing a marketing network solely for the composting projects. He argued by giving an example of Watam Community composting project in Jakarta, Indonesia that if the composting projects do not grow any marketing network of their own, they may fail if the compost distributors lose interest in selling the compost.

The compost manufacturer should have control over the price of the product when it sells through retailers. In the case of Waste Concern, the distribution network members had increased the compost price to keep a good profit margin and this was found to be unaffordable or less competitive compared with locally available organic inputs.

Compost promotion could be done through displays, attractive and informative packaging, brochures and leaflets, advertisement, farmers meetings and acquisition of a suitable brand name or logo. The compost manufacturers in Bangladesh were using leaflets, information brochures, newsletters etc. for promoting the product. It was noted that most of the farmers in Bangladesh were illiterate. It would be wise for the small compost manufacturers to look for cheaper alternatives such as keeping links with the agriculture department, demonstration projects, exhibitions, communication with farmers' organisations etc. Zurbrugg (2003) is also in favour of organising on-farm demonstration or field trials. This could bring benefit both to the farmers who have or have not experience in compost as they could visit and observe the actual effectiveness of compost on crop yield.

8.9 Summary of the chapter

This chapter discussed the demand and marketing aspects of community-based composting projects for two purposes: one is to sell compost and earn revenue for operating the project and the other is to reduce the backlog of stored compost. The present status of production and consumption of organic compost, knowledge and perception of potential users, constraining factors to demand and marketing, and promotion and distribution of compost were taken as indicators to probe the hypothesis 'Community-based composting projects are limited in achieving

sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered'. This chapter was guided by the specific research questions: What is the present trend of organic compost production and consumption? Is knowledge available to the end-users regarding the benefits and use of compost? What are the factors likely to affect the demand and marketing of compost? What marketing strategies are taken for the sale of compost and how they influence the sustainability and replicability of the composting project?

Questionnaire surveys and interviews with potential users were used to gather data which were then analysed by statistical significance as a means of explaining the statement of the thesis.

From the discussion in this chapter the following key points came out to support the hypothesis of the research:

- **Present capacity of production and consumption of compost was very insignificant and it did not bring any impact on compost demand and sale.** From the present production and sale, overproduction was found in the case of Prism and underproduction in the case of Waste Concern. Waste Concern mentioned that there was high demand for compost and they were not able to supply the required amount. On the other hand, Prism could not sell the product due to lack of demand and market development. At this present state of production and consumption of compost, it is difficult for the composting projects to sustain their activities by creating demand or developing markets for the product.
- **Waste derived compost was new to the farmers. Lack of knowledge and experiences about compost hindered compost demand.** Farmers who used waste derived compost had no alternative organic inputs. They used compost with the hope of getting more crops, increasing soil fertility, requiring fewer chemical fertilisers and producing vegetables which would remain fresh for a longer time. Farmers who used compost also had a negative observation on the presence of contaminants, slow plant growth and increased cost of cultivation. But at this initial stage of compost use and from the satisfaction and dissatisfaction level, it is very difficult to measure the real demand for compost.

- **Farmers in the peri-urban areas had basic knowledge about the benefits of organic fertiliser use. But due to lack of knowledge and experience and concern about harmful materials contained in waste derived compost, farmers were uncertain or sceptical about waste derived compost.**
- **Nurseries may be the largest potential outlets for compost in urban areas. But the nurseries were not aware or lacked information about waste derived compost.**
- **City procurement policies had no provision for compost use. Waste derived compost had not yet received attention of the city authority as an effective organic fertiliser.**
- **Agriculture policy of government was supportive of chemical agriculture to bring self-sufficiency in food production. Government provided tax incentives, credit support and loan facilities to promote chemical agriculture which might affect the natural demand of compost and be detrimental to the development of a market for waste derived compost. Small-scale compost manufacturers could hardly survive or sustain their activities if they would sell their compost on credit.**
- **Agriculture extension department might be good avenue to create compost demand but compost from city waste was poorly linked with the agricultural community.**
- **Landownership was an important issue for influencing the farmers' decision to use organic fertiliser in their lands. Farmers who cultivated their own lands were more interested to use organic fertiliser but they were reluctant to use waste derived compost. Shared or rented croppers were neither interested to use organic fertiliser nor waste derived compost. Small land hold farmers did not find any incentive to use organic fertiliser for the long-term sustainability of land productivity. They were more inclined to chemical fertilisers for a quick return on their investment.**
- **Compost demand depends on perceptions of its value, on its quality, comparative price and accessibility to potential users. Compost from city waste might be contaminated with sharp objects and chemicals or even heavy metals. The potential users were discouraged from using compost for quality and safety reasons. Compost was selling at a higher price than both the locally**

available organic fertilisers and the chemical fertilisers in some places. Due to higher price and small quantity production, compost could not compete or maintain demand against the locally available organic inputs.

- **Compost sale through established marketing networks was effective but was discouraging due to the margin of profits shared among the network members that caused a many fold increase in the compost price.** The compost market was mainly confined to rural farmers. Long distance delivery increased the price which might be beyond the purchasing capacity of the potential customers.
- **Credit support to poor farmers and sales incentive to dealers was good for the aggressive sale of compost but would be risky for small-scale compost manufacturers as it might affect cash flow and compost production.**

From the discussion in this chapter, it is found that present production and consumption levels of compost were not sufficient to generate demand and sale. The potential users lacked knowledge and access to information. The government policy, agricultural pattern and landownership were not favourable to compost use. Price of compost was not favourable and affordable to the potential customers. Product distribution and promotion was not effective to create demand and increase sale of compost. At the present production level, product demand and marketing situation, it would be hard for the composting projects to be sustainable or replicable.

CHAPTER-9

SUMMARY OF RESULTS

9.1 Introduction

Chapter-5 to Chapter-8 discussed the analysis and results of the thesis. This chapter presents a summary of the key findings in support of key research questions and hypothesis. The first part of this chapter discusses the key findings of the different aspects of community-based composting projects and directs the focus towards testing the proposition of the hypothesis. The second part of this chapter revisits the case-studies and outlines the potentials and limitations and then proposes a sustainable and replicable community-based composting model for the decision makers and compost manufacturers. This proposed model could be used as a guideline in the cities of Bangladesh as well as in other developing countries with similar socio-economic, institutional and political settings.

9.2 Research questions and key findings

This section presents the findings in relation to the primary and secondary research questions described in Table 3.2 of section 3.5 in Chapter 3, the Methodology and examines the outcomes of the analysis to probe the hypothesis of this research.

Primary research question

How sustainable and replicable are the community-based composting projects for the management of solid waste in developing countries such as Bangladesh?

The key research question was guided by four main aspects in connection with sustainability and replication of the community-based composting projects:

- Community awareness and participation
- Local government perception and attitudes
- Financial viability of the composting projects
- Demand and marketing of compost

These aspects were further explained in details in the secondary research questions and guided by the indicators to probe the hypothesis:

'Community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered'.

Four key fundamental issues were linked and emphasised in the hypothesis: community-based composting, sustainability and replication, and present stage of development and strategic issues (section 3.4 of Chapter 3).

9.2.1 Community awareness and participation

This aspect was described in Chapter 5 and was guided by the four underlying indicators: community motivation and attitude, community acceptability, community ownership and community contribution, and the secondary research questions:

What motivation and attitude does the community have towards composting? What is the impact of composting on the community and how does the community accept it? What is the level of participation of the community? In what way is the community contributing to the composting project which is likely to affect the sustainability and replication of the project?

Findings from the case studies:

Community motivation

Community motivation in this study explained the sensitisation and mobilisation of the community towards waste handling practices. It was found from the study that community motivation and participation was confined to door-to-door waste collection services for the cleanliness of their local environment. They hardly felt responsible for the ultimate disposal of their wastes. The community showed a low level of willingness to pay for composting which indicated that the community residents did not have a felt need or demand for the composting project. The literature indicates that for the sustainability of the community-based project, the community should have a felt-need or demand for the project and must have a willingness to share the project cost (White 1987; McCommon et al. 1990). It can be concluded that

a need based and demand responsive project would be more sustainable and replicable.

Community attitude

Community attitude in this study was examined by studying the practice of separating different types of wastes at the point of generation for the purpose of reuse and recycling. It was found from the study that in the prevailing socio-cultural perspective, the attitude of the residents was not supportive of source-separation without having financial incentives or separate waste collection arrangements, both of which are likely to affect the efficiency as well as long-term sustainability of the composting project. It is clearly stated in the remarks of Furedy (2004) that urban organic waste composting must be reliant on source-separation for its long term success and sustainability.

Community acceptability

In this study community acceptability was used for measuring the tolerance level of the community residents towards municipal solid waste composting. Composting facilities are associated with some environmental and social concerns (odour, vector breeding etc.) which are considered as impediments to siting a composting facility inside the community. It is statistically proven that complaints of odour and other nuisances from the composting facility may be overcome by the involvement and participation of the community in site selection, project planning and consultation. A low level of community involvement in project planning and implementation, and lack of awareness and knowledge of the community about the project activity and its possible impact may constrain the continuation and scaling-up of the community-based composting project. Rahardyan et al. (2004) and Waite (1995) pointed out that community acceptance can be realised by providing appropriate knowledge about the project activity and by keeping the site tidy. Zeiss and Atwater (1991) and Tchobanoglous et al. (1993) laid emphasis on communication with the communities for acceptance of a waste management facility.

Community ownership

Community ownership in this study referred to the feelings of responsibility and belonging of the community towards the composting project for its maintenance and longevity. From the study, it was found that in the composting projects, community involvement was confined to the mobilisation and awareness stage, which was the lowest level of the Arnstein's ladder of community participation. This level of participation was not effective in developing a sense of ownership and responsibility. Ownership of the community-based composting projects could be achieved by the involvement and empowerment of the community residents in project activities from planning to implementation and management. A low level of willingness to pay for composting operations was also an indication of the community's low level of responsiveness or sense of belonging to the project. Sohail et al. (2001) pointed out that in a community level project willingness to pay money is a real test of ownership. Ahmed (2003) laid emphasis on capacity building and access to authority over the project management as a certainty that ownership would be developed.

Community contribution

In this study, community contribution placed emphasis on whether the households served would collectively be willing to pay enough to finance the costs of the composting activity. It was found from the cases that there was a high participation of the community residents for paying the waste collection fees but unwillingness to share the cost of composting. The main factor affecting communities' willingness to pay is the belief that it is the municipal responsibility to dispose of waste. In a case study in Patan, Kathmandu UWEP (1996) identified three factors for willingness to pay for a service: if the community finds it reliable, beneficial and is generated from the demand of the community.

The study findings indicated that the process of community participation in solid waste management, in particular waste composting, only existed on a very limited scale in Bangladesh. The programmes were mostly performed by NGOs and became dependent on donor support. The communities perceived solid waste management activities as the job of the municipality. There was no mechanism to build capacity of the projects to run independently. In this state of development, it would be difficult for the composting projects to sustain their activities when the current support is

withdrawn. The literature discussed community participation as an interactive process in which the beneficiaries could influence the development and management of the projects rather than merely receive the project benefits (Sohail et al. 2001). White (1987) and McCommon et al. (1990) reiterated that the sustainability and replication of the community-based projects could be achieved by the assertions that:

- Community must have demand and a positive attitude towards the project
- Community must feel responsible for the project.
- Community must be willing to share the project cost.
- Community must have the management capacity to run the project.

9.2.2 Local government perception and attitude

This aspect was discussed in chapter 6 and was guided by the three underlying indicators: municipal officials' awareness and attitudes, political will, and policy and legislation, and the secondary research questions:

What awareness and attitudes do local government officials have towards waste reduction and composting? What legal and political environment exists in local government authorities and how does this impact on the sustainability and replication of community-based composting projects?

Findings from the case studies:

Municipal officials' awareness and attitudes

Municipal conservancy officers work in a traditional and bureaucratic waste management system. They lacked knowledge and skills in waste reduction and recycling. There was no institutional culture in the municipality to train the officers to build knowledge and capacity in waste management. The policy making officers had little thought and motivation towards the potential savings on waste reduction through composting. However, in Khulna the municipal officials' attitude was favourable towards composting because the NGO Prism maintained good linkages with the municipality and sought their co-operation and support. It can be concluded that a low level of municipal support and limitation in promoting community-based composting activities are due to a lack of knowledge of the municipal officials about the potential benefits of composting. Zurbrugg et al. (2003b) further added that knowledge or

know-how about composting is confined to NGOs/manufacturers, who do not share their ideas widely.

Political will

Political will in this study referred to the political decisions of the local authorities to extend their support towards community-based composting projects and to give them recognition. In the local government authorities, the prevailing political decision is towards open-dumping for it is a cheap means of waste disposal. The bureaucratic and political environment in the local authorities is not supportive of promoting community initiatives, rather favouring big investment projects. The lack of recognition and bureaucratic attitude of the senior officials towards community-based initiatives could undermine the promotion of community-based initiatives. Plummer (2000) and Gupta (2003) also commented that the promotion of community participation and small-scale intervention is contrary to the development targets of the local authorities and they perceive community/NGO led activity as a threat to their formal activities.

Policy and legislation

The community-based waste collection and composting projects initiated or implemented by the CBOs/NGOs were not generated from the demand of the government policy but were taken solely out of economic and local environmental perspectives. Municipal ordinances on solid waste management gave priority to collection and disposal of waste rather than waste reduction through recycling and reuse.

The awareness and attitude of the municipal officers, institutional culture and political outlook of the local authority and legal limitations are not supportive of promoting community-based initiatives and in this prevailing situation it would be difficult for the community-based composting projects to sustain their activities.

9.2.3 Financial viability

This aspect was discussed in Chapter 7 and was guided by three underlying indicators: capital and operational cost, revenue and cost saving, and commercial value of composting, and the secondary research question:

Is the financial status and commercial value of the community-based composting project favourable to sustainability and replicability?

Findings from the case studies

Capital and operational cost

Community-based composting projects have suffered from diseconomies of scale. The cost of composting per ton was higher than the standard waste management costs of the municipality which indicated that composting would not be financially attractive as a waste disposal option for the local authorities. Man-hour monitoring and labour productivity showed employment of more workers than needed, and poor labour management and supervision which identified inefficient planning and management made the projects financially unsound. Dulac (2001) pointed out that economy of scale of the community-based composting projects depends on productivity of labour; amount of raw materials processed and design capacity of the system. Furedy (2004) commented that as long as composting remained an expensive option for cities, wastes would be disposed of by low cost open dumping by the local authorities.

Revenue and cost saving

Composting of urban organic solid waste would not be financially worthwhile under the current method of cost accounting. Lack of cost assessment and insufficient cost recovery leads to a strong dependence on external financial assistance. However, if the landfill savings are to be diverted as subsidies for the composting projects, then composting projects would be found financially creditable. Mbuligwe et al. (2002) and Chakraborty (1999) calculated surplus over the operational costs of composting, when the landfill savings are accounted for in the cost assessment.

Commercial value of composting

The sustainability or widespread replication of the composting projects is unlikely to occur unless they exhibit a financial return. Financial and commercial viability require careful estimation and planning, and improvements in the conventional financial system. The compost would not be more attractive as a commercial product than the

chemical fertiliser and locally available organic inputs, in terms of price and fertiliser value.

9.2.4 Demand and marketing of compost

This aspect was discussed in Chapter 8 and was guided by four underlying indicators: present status of compost production and consumption, knowledge and awareness of the potential users, factors constraining demand and marketing, and marketing strategies, and the secondary research questions:

What is the present trend of organic compost production and consumption? Is knowledge available to end-users regarding the benefits and use of compost? What are the factors likely to affect the demand and marketing of compost? What marketing strategies are taken for the sale of compost and how do they influence the sustainability and replication of the composting project?

Findings from the case studies

Present production and consumption

The existing capacity of production and consumption of compost was very insignificant. Compost production was not sufficient to meet the actual demand or the market development would not keep pace with the compost production, which in turn could lead to failure of the composting projects. Furedy and Kulkarni (2004) and Davies et al. (2004) found that NGOs and CBOs operating community composting projects were more interested in experimenting rather than exploring markets for the product which was an unsustainable approach to waste management.

Knowledge and perception of end-users

The potential users of compost lacked knowledge and access to information. Lack of knowledge about compost benefits, practical experiences and concerns about potential pollution of mixed waste compost could hinder compost demand. Brook and Davila (2000) and Somda et al. (2002) confirmed that farmers were reluctant to buy or use compost as they had uncertainty about how it would be valued and priced.

Factors constraining compost demand and marketing

Compost demand and marketing depends on perceptions of its value and accessibility to potential users, on its quality and comparative price. The availability of credit and fiscal incentives for chemical fertilisers were critical constraints to the popularity of compost use among the farmers. The government policy, agricultural patterns and landownership were not favourable for compost application. Dulac (2001) stressed the importance of government support and links, especially with the agriculture community, for sustainable production and marketing of compost. Solid waste compost has a negative image in terms of pollutants. Compost quality and safety are essential to gain a market demand of the product. Kim (1995) in Bangkok and Mbuligwe et al. (2002) in Dar es Salaam, Tanzania identified low quality waste derived compost as a difficulty in creating demand and in consequent sustaining of the composting operation. Compost was comparatively expensive and unappealing to farmers. Dreshsel and Kunze (2001) mentioned that in Ghana, Africa, farmers had high willingness to use and pay for compost because it was less expensive when compared to chemical fertilisers.

Marketing strategies

This study discussed marketing strategies of compost in terms of delivery (transport and distribution) and promotion. Delivery is defined as the availability of the product to the end-users at a right price and promotion consists of informing and demonstrating the benefits of composts in order to increase demand and sale. This study supported the use of networks of specialised marketing companies for compost sale but discouraged the network members from jeopardizing price increases in order to maintain profit margins. This study criticised the promotional techniques such as leaflets, information brochures, newsletters etc. adopted by the compost manufacturers and encouraged keeping links with the agricultural department, project demonstration, exhibitions and communication with the farmers' organisations. Zurbrugg (2003) was also in favour of field trials of the product effectiveness on crop growth which could easily and quickly bring out attention of the farmers.

9.3 General findings from the study

From the study, it is evident that local governments' inability to provide solid waste management services has been the major factor leading to the flourishing community-based initiatives in Bangladesh. The study also indicates that financial contribution in community-based projects is based on the effective demand for the service from the beneficiaries. Decisions regarding the public services such as waste management are commonly taken at a political or administrative level which ignores the potential of a local level solution. The small-scale composting projects are associated with risks in health and safety issues, public displeasure from nuisance and hazards, lack of government priority and uncertainty in demand and market development. For effectiveness and sustainability of the public service, decision needs to be taken at a level as close as possible to the source of the problem and in consultation with the people most directly affected and concerned. There is no clear policy on public-private role sharing in waste management, thus public-private partnership is not formally exercised. However, the private sector formally and informally complements many areas of public services such as public transport, primary health care, primary education etc. The private sector interventions have proved the most efficient, since they operate services according to business management principles.

Some of the important and specific findings of the study are:

- Participation of the community could be restricted to paying for and supervision of waste collection activities.
- Source-separated organic waste collection is important for producing relatively contaminant-free compost. Conscientious efforts of waste generators and efficient waste collection programmes could accomplish successful source-segregation practice.
- Municipalities have legal limitations in promoting community activities. Building a knowledge base and skills of the local authorities, and establishing policy and legislation is important to acquire support and recognition of community-based initiatives and organic waste recycling.
- Improvements are needed in conventional financial systems. Lack of cost assessment and insufficient cost recovery can lead to a strong dependence on external financial assistance. Representation of the total value of resources in

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- Improvements are needed in conventional financial systems. Lack of cost assessment and insufficient cost recovery can lead to a strong dependence on external financial assistance. Representation of the total value of resources in waste through full cost accounting systems could encourage the participation of the local authority as well as the business sector.
- Compost market is potential and emerging. Compost has to compete with chemical fertilisers and alternative organic fertilisers in the fertiliser market. The Ministry of Agriculture could take a leading role in developing compost demand and marketing.

9.4 Proposed community-based composting model

In this section, first the strengths and weaknesses of the four community-based composting projects are revisited and then through a cross-sharing process, a generalised and sustainable model with working guidelines is developed for replication in the cities of Bangladesh as well as in other developing countries with similar socio-economic and political settings. Primary waste collection, composting activity, marketing and sale are the essential components of the community-based composting projects. The community, government, private sector, NGOs, community-based organisations (CBOs), Waste management committees (WMCs) are all considered as collaborators of the proposed composting model.

From the analysis of strengths and weaknesses of the composting projects, it was observed that when the donor funds through NGOs become exhausted, the composting activities are likely to collapse. Community input in the composting projects did not develop ownership feelings or build capacity of the community for carrying out the projects for their lasting effect. This study proposes a more stable composting model in which both the community interest and the business objective of the private sector would be served.

It was evident from the study that community residents were more interested in the cleanliness of their neighbourhood environment, rather than the ultimate disposal or recycling of their wastes. They were enthusiastic about paying waste collection charges but indifferent to paying for the composting operation. From the motivational level of the community, it would be better to allow the primary waste collection

service to function independently of composting and to come under the control (both management and financial) of the community. The small private entity could be encouraged to finance. Finance of such a small private entity could get confidence by ensuring the political support of the local authorities. Local authorities could be motivated by the potential savings of waste management costs by the practice of composting. In this regard, the proposed community-based composting model would be a partnership between the community, local government and small private enterprise with roles and responsibilities of the different actors as follows:

- Primary waste collection service could be organised directly by the community.
- Waste management committees (WMCs) could be formed from the beneficiaries to monitor the CBOs activities.
- NGOs could extend their assistance by mobilising the community to practise source-separation and provide capacity building support for developing skill and knowledge.
- Local government, as a facilitator to community-based projects, could provide land and other logistical support as subsidy.
- Private enterprise could finance the composting projects on a 'running a business and serving the community' attitude. It could seek the co-operation of the community by providing incentives. These incentives may be the supply of waste containers to the community to encourage source-separation, and provision of waste collection carts to the CBOs.
- Private enterprise should target all the potential marketing channels and adopt cost-effective promotional techniques for compost sale.

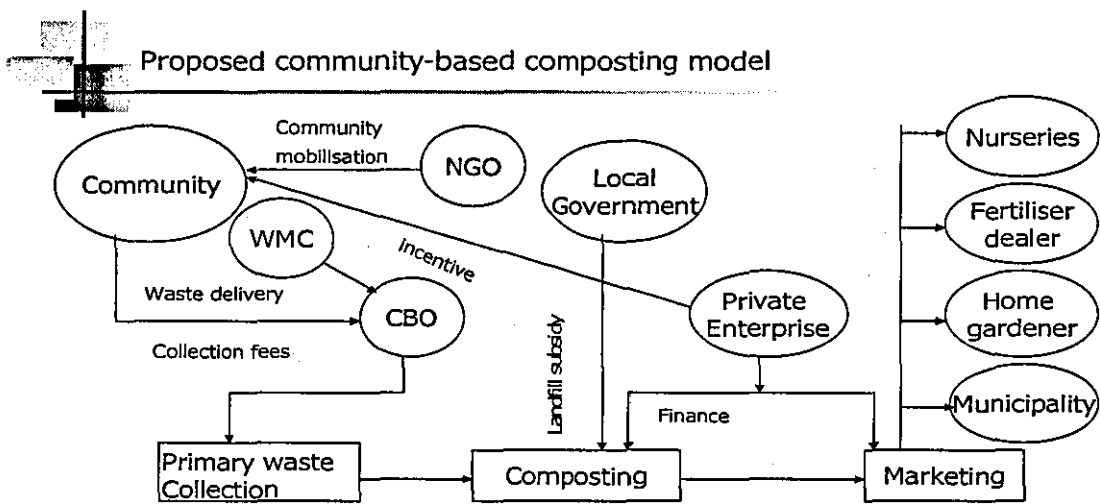


Fig 9.1: Proposed community-based composting model.

The community-based composting projects that were studied in the cities of Bangladesh were in pilot stages, where there were limitations in product quality, of perceptions of customers on value and price, of economics, and of compost demand and promotion. The proposed model will not be realistic or can not be directly applied in the field under existing conditions. Some changes and improvements in the composting operation, government support and promotion, and economics of the projects are necessary to encourage private sector investment in the composting business.

9.5 Application of the composting model

This model may be useful for the policy makers, private sector investors and practitioners. The major significance of the model is that it is not prescriptive; it has flexibility and takes many forms with the possible leading role of local government authorities, NGOs or CBOs. But in every approach, the target would be to consider community-based composting as part of a potential solution to the solid waste problems of the cities and the private sector could be utilised in marketing the compost. Other forms of this model could be as follows:

The local government authorities, within their development programme, can construct and operate the composting facility and integrate the CBO-operated primary waste collection service with the composting activity. NGOs could provide capacity building support to develop skills and knowledge of the community.

NGOs can also implement this type of project by involving the CBOs in primary waste collection services. They can organise initial funds for facility construction and negotiate with the local government authority for their support in utilising the compost on a buy-back arrangement. This can build capacity of the CBOs and develop the transferral mechanism of the projects for their continuation, discouraging the dependence on external assistance.

CBOs can also operate composting projects in addition to the primary waste collection service in order to make income from waste. In this case, CBOs need to develop both managerial and financial capacity. Such a project can gain the support of the local authority in the form of land, infrastructure or municipal workers. NGOs can work in advocacy to increase awareness and knowledge of the community about the benefits of composting and can motivate the community residents to pay for composting.

9.6 Summary

This chapter summarised the research findings around the key research questions and the hypothesis. The findings were also focused on probing the hypothesis. The research highlighted the present stage of development, which indicated that some modifications or improvements would be needed to develop a sustainable and replicable model suitable for the cities of Bangladesh as well as in other developing countries with similar socio-economic and political settings. In this connection, by evaluating the strengths and weaknesses of the different forms of community-based composting projects and by reviewing the literature, a generalised sustainable and replicable community-based composting model is proposed.

This proposed model concentrated on the partnerships between the community, local government and the private business sector. This model is flexible and can be implemented in other forms with the leading role being taken by local government, NGO or CBOs. For the implementation of this model, some modifications are needed

with respect to capacity building of the community, policy and political priority of the local government. This research discourages the dependence on long-term donor funding, which could inhibit the direction of project development towards self-sustainability and widespread replication.

CHAPTER-10

CONCLUSION

10.1 Introduction

Community-based solid waste management, in particular waste collection and recycling, has made a significant contribution in the developing countries. A body of literature explains the extent and nature of those community-based initiatives. There has been scope found for research into the sustainability and replicability of those community-based activities. This thesis has been an attempt to study the state of sustainability and replication potential of community-based composting projects. 'Sustainability' was defined in this thesis both in terms of 'meeting the present needs' and also in terms of 'long-term durability' of the projects: namely the projects would not collapse upon withdrawal of external support, rather local capacity and interest would be developed such that projects continue to function when external agency support is withdrawn. 'Replication' was defined as the potential for creation and operation of a large number of similar sustainable projects for the management of solid waste in the cities. Four existing community-based composting projects in Bangladesh were investigated with an intention to determine:

- the extent of community participation
- the political support of the local authority
- the economics of the project
- the demand and market potential of compost.

This thesis, in line with the hypothesis, found that sustainability and replicability of the community-based composting projects were not possible under existing conditions. Some strategic issues needed to be addressed. This chapter concludes the thesis by highlighting some recommendations from the overall research design and findings and outlines some scope for further research.

10.2 Recommendations

This research was directed towards the partnership of three main stakeholders-community, local government and private business sector. In the research design and follow up process, the social, political, environmental and economic contexts were discussed. The technology of the composting process was outside the purview of this research. The research was solely confined to the cases of community-based composting projects which were low cost, labour-intensive and suited to the socio-economic context of the developing countries. The hypothesis which guided the whole research was **'Community-based composting projects are limited in achieving sustainability and replication potential at their present stage of development in the cities of Bangladesh; hence some strategic issues need to be considered.'** The hypothesis emphasised the limitations of the composting projects at their present stage of development and allowed scope for addressing some recommendations for further development to ensure sustainability and replicability.

- It is essential to identify goals of the composting projects, whether composting is planned for demonstration or educational purposes or as a means of recycling organic materials for a solution of the city waste problem.
- A composting model comprising the community, local government and private business enterprise should be ideal for community-based waste management, where the community should organise primary waste collection, and the private business sector should operate the composting facility. Local government should act as a facilitator by diverting some of the financial savings as subsidy to the composting projects.
- Community participation should not be limited to the mobilisation and sensitisation stage of community development. Setting up a dialogue with community people and engaging them in the planning and decision making process is likely to increase public confidence. Providing information about the composting activity may help to dispel any opposition to siting the composting facility. Involving the community in consultation, the decision making process, implementation and monitoring can ensure sustainability since it empowers the local community, encourages them to contribute and gives them a sense of responsibility and commitment.

- Low levels of municipal support and acceptance of the community initiatives are due to a lack of knowledge and awareness of the municipal officials. Municipal officials should be provided with comprehensive training in community development, the participatory approach, and the technical and commercial value of solid waste and its subsequent management.
- The laws and regulations in most of the developing countries are outmoded and not supportive of reuse and recycling of waste. Enactment and implementation of policies and legislation, economic and non-economic incentives for organic waste recycling and its application are essential and could have a positive impact on solid waste management.
- Political support is needed for community-based composting projects to succeed. It is important to inform the elected representatives of the local authority about the objectives and goals of the projects in order to win approval or recognition. This will help the local authority to develop a strategy for organic waste management and recycling, and gain strong political support to bring organic waste management into the mainstream of the municipal development programme.
- Composting can significantly reduce waste stream volume and offers economic advantages to the local authorities. Inadequate understanding of the economics of composting is a challenge for the composting projects. A full and realistic accounting system should be practised in financial and economic assessment of composting. This could motivate the municipal authorities to extend their support towards the composting activities.
- Chemical fertilisers are heavily subsidised by the government which affects the natural demand for compost. Government should be motivated to provide subsidies or incentives for organic fertiliser production and sale to allow for its widespread use.
- The main challenge of the composting projects is to identify potential markets for the compost. The Ministry of Agriculture must take a leading role in demand creation and market development for the compost.

10.3 Scope for further research

- Waste collection and cleanliness were the main priorities of the community residents and they were motivated to pay for the waste collection services. Composting was regarded as the government's job and they were reluctant to pay for composting activity. True participation would only occur when there was a willingness to pay for the service. Direct charging of households for the management of the waste they produce, as with other essential services such as gas, electricity and water, may be proposed to encourage their participation in waste minimisation and recycling activities. There is scope for further study to assess willingness of households to pay for the management of the waste they produce irrespective of municipal taxes.
- The composting projects rely on the household segregation of waste for controlling contaminants, and this necessitates a high level of participation by the residents. A further study could work on what motivations or procedures are required to influence the residents in source-separation for composting.
- The study found that the composting projects were not running at economy of scale. Planning and estimation must make allowance for the quantities of feedstock materials in the composting facilities. A further study could assess the amounts and quality of feedstock materials available in the community to achieve optimum utilisation in the plants. These data can help to determine the size of the plant and space requirements as they all contribute to the economics of the operation.
- Odour and vector breeding are crucial problems in operating open windrow pile composting in the community. There is further scope for study on the most suitable technology to mitigate the adverse impacts of a composting operation inside the community.
- Large-scale mechanised composting projects are too expensive, too complicated and not tailor-made to the local condition of the developing countries. The windrow method in the community-based composting projects is less expensive but requires a large amount of land space per unit of waste treated. In the urban areas where land prices are higher, it would be

economic to select an alternative process which utilises less land. A further study could work on the development of a composting process which could save land and reduce costs to a reasonable level.

- Local government authorities are mandated for waste collection and disposal. Further study could investigate what institutional arrangements and approaches are required for creating a conducive environment in the local authority for community-based activities and what system drivers are required to facilitate private and community involvement in formal waste management.
- Keeping records on actual cost is essential for the economic assessment of the projects. A further study could work on an appropriate financial management model for the composting projects which can represent the cost figures in a transparent way.
- The study found that land ownership patterns and agriculture practices could influence compost demand. Further study is required on how the impact of agro-ecological locations and the access to credit facilities could influence compost demand and sale.
- The study found that the price of compost depends on transport distance and the price of the alternative products. Further study will investigate how compost quality could influence the price of the compost.
- The developing countries have to meet the challenge of inadequate or non-existent standards for compost. A further study could investigate whether the quality of compost can directly impact on marketability.

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APPENDIX-A

Basic data on composting process

Basic data on Composting Process (Data supplied by the Plant operator)

*Plant Name: Dhalpur Compost Plant
Dhalpur, Dhaka*

1. For Collection

- a) Collection Area: Ward No. 30, 85 (Partial Coverage)
- b) No of Household Covered: Golapbagh (50H/H), City Corporation staff quarter (135 H/H), East Maniknagar (105 H/H), Maniknagar (150 H/H).
- c) No. and Size of the van engaged: 3 Nos. (1 stand by) L: 54", W: 31", Ht: 39"
- d) Year of Manufacturing of Vans: 2001
- e) Cost of Manufacturing of the Vans: 12,000TK
- f) Repair Cost of Vans: 1000Tk/year
- g) Estimated Life of the Van: 5 Yrs
- h) No. Of workers involved: 6 [1 man and 5 women]
- i) Time departure from the plant:

Van No. 4	11:15
Van No. 3	11:40
Van No. 2	11:25
- j) Distance of first household from the plant:

Van No. 4	100m
Van No. 3	700m
Van No. 2	600m
- k) Distance of last household from the plant:

Van No. 4	300 m
Van No. 3	1000m
Van No. 2	800m
- l) Time of arrival at the plant:

Van No. 4	15:15
Van No. 3	15:00
Van No. 2	14:45

m) No. of trips per van:

Van No. 4 2

Van No. 3 1

Van No. 2 1

n) Amount of waste collected by the van:

Van No. 4 278 kg

Van No. 3 158 kg

Van No. 2 225 kg

o) Seasonal variation of waste: Summer (Max) 726 Kg/day, winter (Min) 660

Spring (Mid) Autumn (Mid) – 690 kg

p) Collection fees: TK 10-15 Per household, Total fees: TK 6000/month

q) Salary of the workers: Worker: 5@1000Tk/month, Vanpuller 1@1200TK,

r) Any other income of the workers: Sale from inorganic recyclables 1000
TK/Month

s) Type and materials of the waste bags of containers used by the households:

Plastic Bucket, Paper bag, Polythene bag

t) Size and number of bags/ containers: large/ medium/ small: 10 Liter water
holding Capacity.

u) Average generation of waste per household: 1.5 kg/day

v) Road Condition: pavement (Good/ bad): Good

w) Traffic congestion: Yes/ No: No

Same workers and in same numbers are involved in collection, sorting, piling, turning, screening and for packaging and storing.

2. *Sorting*

a) No. of workers involved: 6 Nos.

b) Time starts for sorting: 2:30PM- 3:00 PM

c) Time ends for sorting: 4:00PM

d) Amount of organic matters: 496 Kg/day, About 80% of Total Raw Waste

e) Amount of rejects: 115 Kg/Day,

f) Amount of recyclable: 50 Kg

g) Income from recyclable: 800-1000 TK/Month

3. Piling or loading of Waste

a) No. and size of aerators/ Box:

No of aerator -4 (Size: L-10ft, H- 1.75 ft., capacity 4.5 ton (Approx.)

No of Box - 6 [Size(1 to 4) L- 11.33ft, W- 3.5 ft, H- 3.67 ft, 4120 kg/Box

Size (5 &6) L- 9.33ft, W-3.67 ft, H-3.5 ft, 3390 kg/Box] (7 days waste)

b) No. of workers involved: 6 Nos.

c) Starting time for piling: 4:00 PM

d) Ending time: 5:00 PM

e) Length and height of the pile everyday: L-10ft , W-5ft, H-3ft.(2 days waste)

f) Temperature in the pile: High 70⁰C, Low 40⁰ C

g) Cost of manufacturing of aerators or box: Aerator 2000Tk, Box 6000-8000 Tk.

4. Turning (Required for windrow aerated system)

For Box – No turning

For Aerator- 1-2 turning for a cycle (40 days)

a) No. of workers involved:

b) Starting time:

c) Ending time:

d) No. of turning in a batch (Avg.)

e) Temp. in the pile

5. Maturation & Screening

a) Composting (decomposition) period: 40 days

b) Maturation period: 10-15 days

c) Temperature in the stack: <40⁰ C

d) No. of workers involved in screening:

First screening:

Second screening:

Third screening:

Residue screening:

e) Time record for first screening: 3.5 man-hour (output about 138 kg)

f) Time record for second screening: 2 man-hour (output about 81kg)

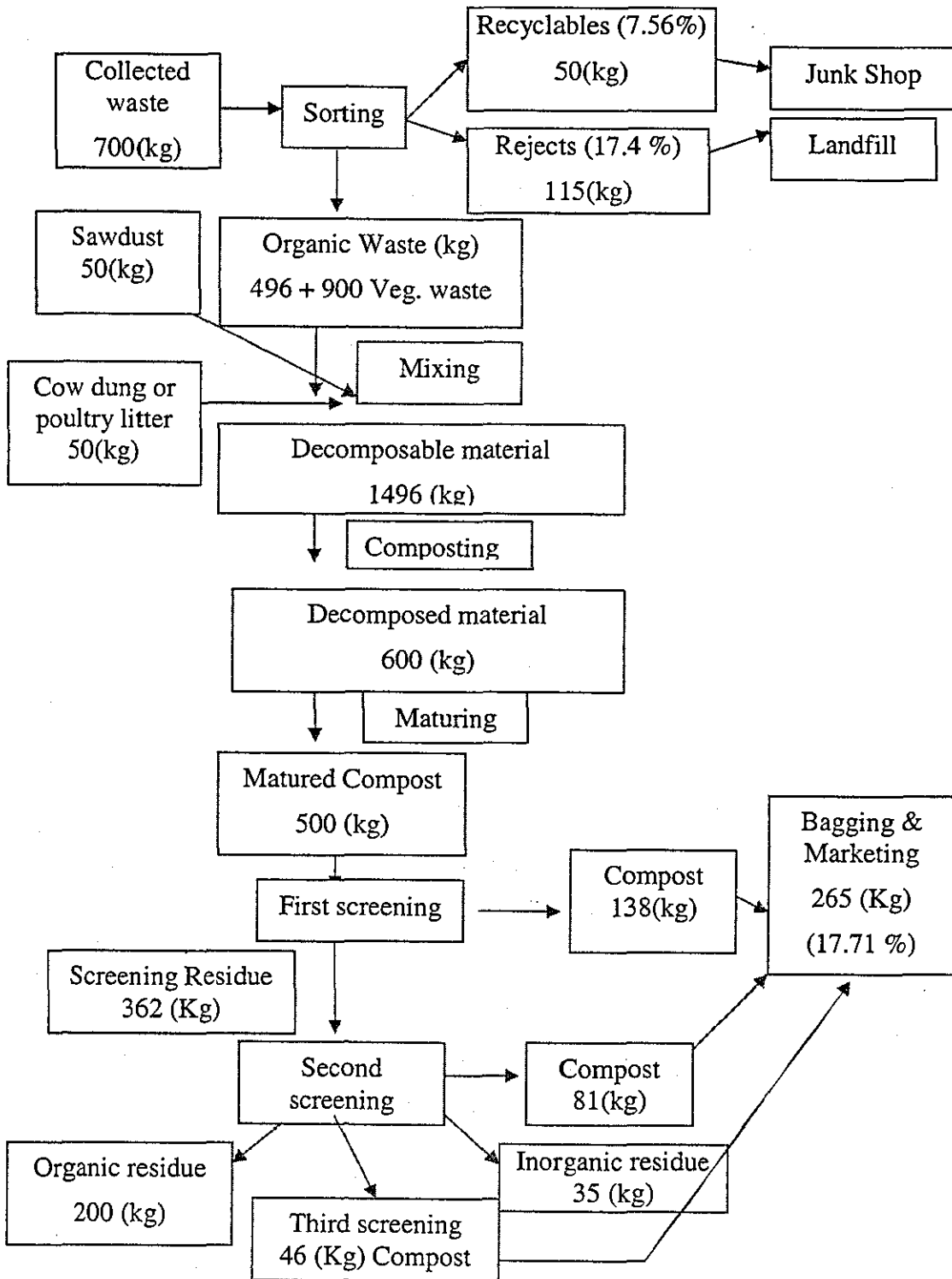
g) Time record for third screening: 1.5 man-hour (output about 46kg)

h) Size of the screen: 8 mm sieve size (5ft * 3 ft)

6. Bagging (Packaging)

- a) Size of the bag: 40 kg
- b) No. of workers: 6
- c) Time required for bagging: 8 bags/hour

Material flow Diagram of the Composting Process



Basic data on Composting Process (Data supplied by the Plant operator)

*Plant Name: Green Road Compost Plant
Green road, Dhaka*

1. For Collection

- a) Collection Area: Ward No. 51 (Green Road staff quarter)
- b) No of Household Covered: 543 H/H
- c) No. and Size of the van engaged: 3 Nos. L: 54", W: 31", Ht: 39"
- d) Year of Manufacturing of Vans: 2001
- e) Cost of Manufacturing of the Vans: 12,000TK
- f) Repair Cost of Vans: 667 Tk./year
- g) Estimated Life of the Van: 5 Yrs
- h) No. Of workers involved: 5
- i) Time departure from the plant:
 - Van No. 1 11:30-12:00
 - Van No. 2 11:30-12:00
 - Van No. 3 11:30-12:00
- j) Distance of first household from the plant:
 - Van No. 1 40m
 - Van No. 2 100m
 - Van No. 3 100m
- k) Distance of last household from the plant:
 - Van No. 1 1000 m
 - Van No. 2 1000m
 - Van No. 3 1000m
- l) Time of arrival at the plant:
 - Van No. 1 15:30-16:00
 - Van No. 2 15:30-16:00
 - Van No. 3 15:30- 16:00
- m) No. of trips per van:
 - Van No. 1 1
 - Van No. 2 1
 - Van No. 3 1

n) Amount of waste collected by the van:

Van No. 1 181 kg

Van No. 2 181 kg

Van No. 3 181 kg

o) Seasonal variation of waste: Summer (Max) 650 Kg/day, winter (Min) 540

p) Collection fees: TK 10 Per household, Total fees: TK 5000/month

q) Salary of the workers: Worker: 5@1400Tk/month,

r) Any other income of the workers: Sale from inorganic recyclables

s) Type and materials of the waste bags of containers used by the households:

Plastic Bucket, Paint bucket

t) Size and number of bags/ containers: large/ medium/ small: 10 Liter water holding Capacity.

u) Average generation of waste per household: 1.5 kg/day

v) Road Condition: pavement (Good/ bad): Good

w) Traffic congestion: Yes/ No: No

Same workers and in same numbers are involved in collection, sorting, piling, turning, screening and for packaging and storing.

2. *Sorting*

a) No. of workers involved:5 Nos

b) Time starts for sorting: 2:30PM- 3:00 PM

c) Time ends for sorting: 4:00 PM- 4:30 PM

d) Amount of organic matters: 450-500 Kg/day

e) Amount of rejects: 50 Kg/Day,

f) Amount of recyclable: 100 Kg

g) Income from recyclable: 35 TK/day

3. *Piling or loading of Waste*

a) No. and size of aerators/ Box:

No of Box -4 [Size L- 10ft, W- 4 ft, H- 4 ft]

b) No. of workers involved:5 Nos

c) Starting time for piling: 4:30 PM

d) Ending time: 5:15-5:30 PM

e) Length and height of the pile everyday:

f) Temperature in the pile: High 70°C, Low 30°C

g) Cost of manufacturing of aerators or box: Box 6000 Tk.

4. Turning (Required for windrow aerated system)

For Box – No turning

- a) No. of workers involved:
- b) Starting time:
- c) Ending time:
- d) No. of turning in a batch (Avg.)
- e) Temp. in the pile

5. Maturation & Screening

- a) Composting (decomposition) period: 50 days
- b) Maturation period: 15 days
- c) Temperature in the stack:
- d) No. of workers involved in screening:5

First screening:

Second screening:

Third screening:

- e) Time record for first screening: 1.5 man-hour (output about 52 kg)
- f) Time record for second screening: 0.5 man-hour (output about 30 kg)
- g) Time record for third screening: 0.5 man-hour (output about 18 kg)
- h) Size of the screen: 8 mm sieve size (5ft * 3 ft)

6. Bagging (Packaging)

- a) Size of the bag: 40 Kg
- b) No. of workers: 5
- c) Time required for bagging: 8 min/bag

Basic data on Composting Process (Data supplied by the Plant operator)

**Plant Name: Mirpur Compost Plant
Mirpur, Dhaka**

1. For Collection

a) Collection Area: Ward No. 7 (Partial Coverage)

b) No of Household Covered: 910 H/H.

Van No. 1 260 H/H

Van No. 2 260 H/H

Van No. 3 130 H/H

Van No. 4 130 H/H

Van No. 5 130 H/H

c) No. and Size of the van engaged: 5 Nos. L: 54", W: 31", Ht: 39"

d) Year of Manufacturing of Vans: 2001

e) Cost of Manufacturing of the Vans: 12,000TK

f) Repair Cost of Vans: 1000 Tk/year

g) Estimated Life of the Van: 5 Yrs

h) No. of workers involved: 7 per time

i) Time departure from the plant:

Van No. 1 9:30

Van No. 2 9:30

Van No. 3 14:00

Van No. 4 14:00

Van No. 5 14:00

j) Distance of first household from the plant:

Van No. 1 500m

Van No. 2 500m

Van No. 3 10m

Van No. 4 10m

Van No. 5 10m

k) Distance of last household from the plant:

Van No. 1 1000m

Van No. 2 1000m

Van No. 3 500m

Van No. 4 500m

Van No. 5 500m

l) Time of arrival at the plant:

Van No. 1 13:00

Van No. 2 13:00

Van No. 3 16:00

Van No. 4 16:00

Van No. 5 16:30

m) No. of trips per van:

Van No. 1 2

Van No. 2 2

Van No. 3 1

Van No. 4 1

Van No. 5 1

n) Amount of waste collected by the van:

Van No. 1 800 Kg

Van No. 2 800 Kg

Van No. 3 400 Kg

Van No. 4 400 kg

Van No. 5 400 kg

o) Seasonal variation of waste: Summer (Max) 3000 Kg/day, winter (Min) 2200

p) Collection fees: TK 10-15-20 Per household, Total fees: TK 17100/month

q) Salary of the workers: Worker: 7@1028Tk/month, Plant worker 12 @1408TK,

r) Any other income of the workers: Sale from inorganic recyclables

s) Type and materials of the waste bags of containers used by the households:

Plastic Bucket

t) Size and number of bags/ containers: large/ medium/ small: 30 Liter water holding Capacity.

u) Average generation of waste per household: 3 kg/day

v) Road Condition: pavement (Good/ bad): Good

w) Traffic congestion: Yes/ No: No

2. *Sorting*

a) No. of workers involved: 12 Nos

- b) Time starts for sorting: 8:00 AM
- c) Time ends for sorting: 11:00 AM
- d) Amount of organic matters: 2200 Kg/day,
- e) Amount of rejects: 125 Kg/Day,
- f) Amount of recyclable: 375 Kg
- g) Income from recyclable: 1200 TK/Month

3. Piling or loading of Waste

- a) No. and size of aerators/ Box:
No of aerator - 20 (Size: L-8ft, H- 2 ft., capacity 5 .5 ton (Approx., 2 days waste)
- b) No. of workers involved: 12 Nos
- c) Starting time for piling: 10:30 AM
- d) Ending time: 14:00 AM
- e) Length and height of the pile everyday: 8 ft * 6ft* 4 ft
- f) Temperature in the pile: High 70⁰C, Low 38⁰ C
- g) Cost of manufacturing of aerators or box: Aerator 1200Tk

4. Turning (Required for windrow aerated system)

- a) No. of workers involved: 4
- b) Starting time: 11:00
- c) Ending time: 13:00
- d) No. of turning in a batch (Avg.)- 2
- e) Temp. in the pile 39 ° C to 70 ° C

5. Maturation & Screening

- a) Composting (decomposition) period: 40 to 50 days
- b) Maturation period: 15 days
- c) Temperature in the stack: 38° C to 55 °C
- d) No. of workers involved in screening:
First screening :
Second screening :
Third screening :
- e) Time record for first screening: 4 man-hour (output about 155 kg)
- f) Time record for second screening: 2 man-hour(output about 90kg)
- g) Time record for third screening: 1.5 man-hour(output about 52 kg)

h) Size of the screen: 8 mm sieve size (5ft * 2.5 ft)

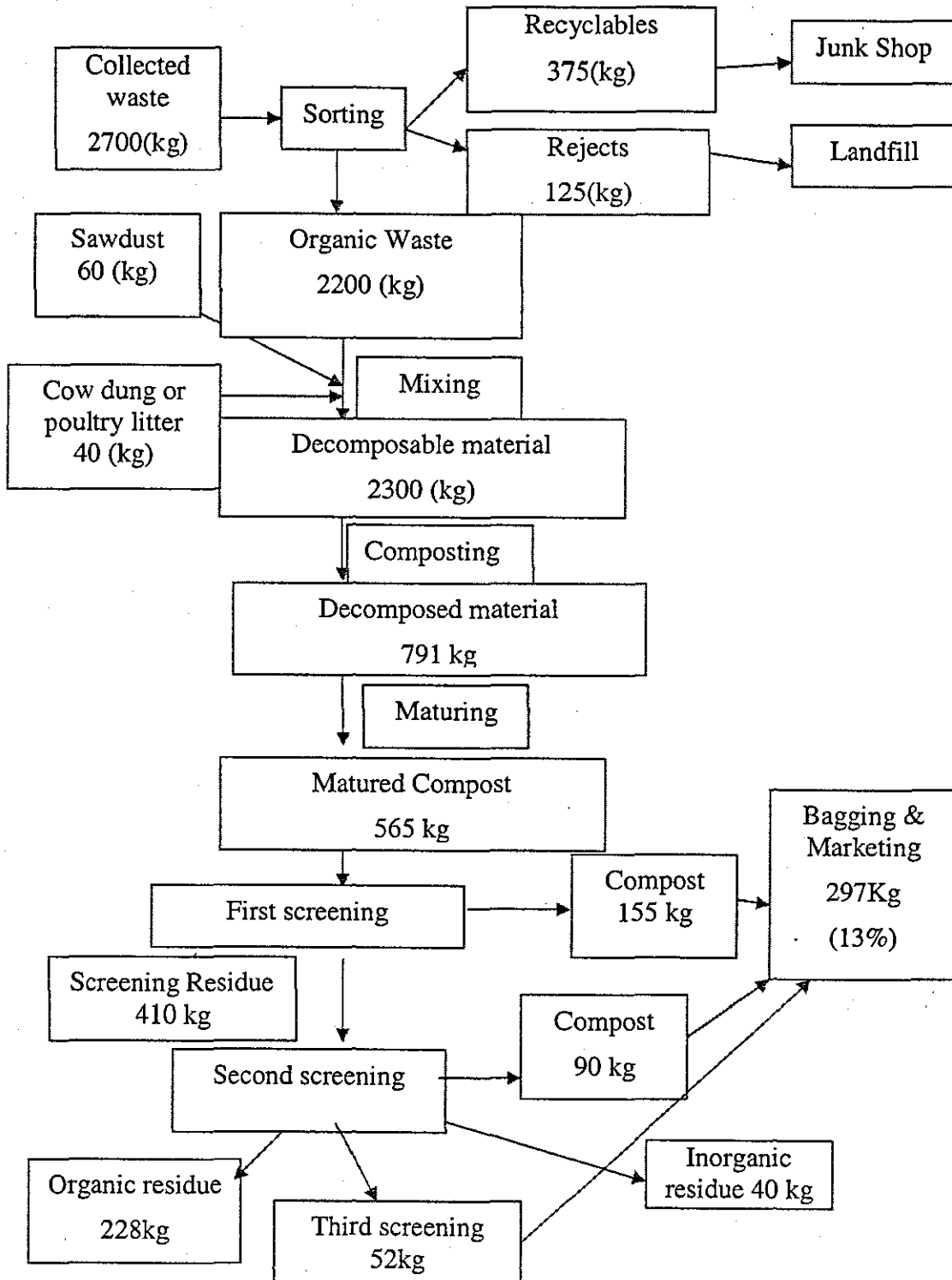
6. Bagging (Packaging)

a) Size of the bag: 40 kg

b) No. of workers: 12

c) Time required for bagging: 8 min/bag

Material flow Diagram of the Composting Process



Basic data on Composting Process (Data supplied by the Plant Operators)

Plant Name: PRISM- SPS Compost Plant

Plant No-01

Boira, Khulna

1. For Collection

- a) Collection Area: Ward No. 9,14, 15 (Partial Coverage)
- b) No of Household Covered: 1300-1500 (Compost Plant Receives waste from 1100-1200)
- c) No. and size of the van engaged: 6 Nos. L: 54", W: 34", Ht: 29"
- d) Year of Manufacturing of Vans: 3 yrs
- e) Cost of Manufacturing of the Vans: 6@8,000TK
- f) Repair Cost of Vans: 6@200Tk/Month
- g) Estimated Life of the Van: 4-5 Yrs
- h) No. Of workers involved: 16 [Worker and Guard: 3, Plant Supervisor: 1, Vanpuler: 6@1, Van Helper 6@1]
- i) Time departure from the plant: 12.00 AM
- j) Distance of first household from the plant: 50 Meter
- k) Distance of last household from the plant: 3.5 Km
- l) Time of arrival at the plant: 2 .30PM
- m) No. of trips per van: Single Trip
- n) Amount of waste collected by the van: 150kg/day
- o) Seasonal variation of waste: Summer (Max), winter (Min) Spring (Mid) Autumn (Mid)
- p) Collection fees: TK 10-15 Per household, Total fees: TK 20000
- q) Salary of the workers: Worker: 2@1200Tk, Worker cum guard: 1@1500Tk, Vanpuller 6@1600TK, Van Helper: 6@ 500TK, Supervisor: 1@3000TK
- r) Any other income of the workers: workers 3@350-400TK/Month
- s) Type and materials of the waste bags of containers used by the households: Plastic Bucket,

t) Size and number of bags/ containers: large/ medium/ small: 17 Liter water holding Capacity 568 for Separation at sources, 25 Nos Plastic Container capacity 50 Liter.

u) Average generation of waste per household: 1-1.5 kg, In Slums 0.5-1.0kg

v) Road Condition: pavement (Good/ bad): Not Bad (Medium)

w) Traffic congestion: Yes/ No: No

2. *Sorting*

a) No. of workers involved: 3 Nos.

b) Time starts for sorting: 2:30PM

c) Time ends for sorting: 4:30PM

d) Amount of organic matters: 600-800 Kg/day, About 80% of Total Raw Waste

e) Amount of rejects: 100-300 Kg/Day,

f) Amount of recyclable: 850-1000 KG/Month [Paper, Cardboard, Coconut Shell, Wood, Plastic Bottle etc]

g) Income from recyclable: workers 3 @ 350-400TK/Month

Same worker and in same numbers are involved in sorting, piling, turning, screening and a part of workers (2/3) for packaging and storing.

3. *Piling or loading of Waste*

a) No. and size of aerators/ Box: Bamboo 10Nos(8'), Polyvinyl Chloride Perforated (PVC): 12 Nos. (4'-5')

b) No. of workers involved: 3 Nos.

c) Starting time for piling: 4:30 PM

d) Ending time: 6:00 PM

e) Length and height of the pile everyday: 8'-1. 5'

f) Temperature in the pile: 40°C

g) Cost of manufacturing of aerators or box: Bamboo @300Tk, PVC @200Tk

4. *Turning (Required for windrow aerated system)*

a) No. of workers involved: 3 Nos.

b) Starting time: 10:00 AM

c) Ending time: 12:00 AM

d) Temperature in the pile: <55 °C

5. *Screening*

a) Composting (decomposition) period: 45-60 days

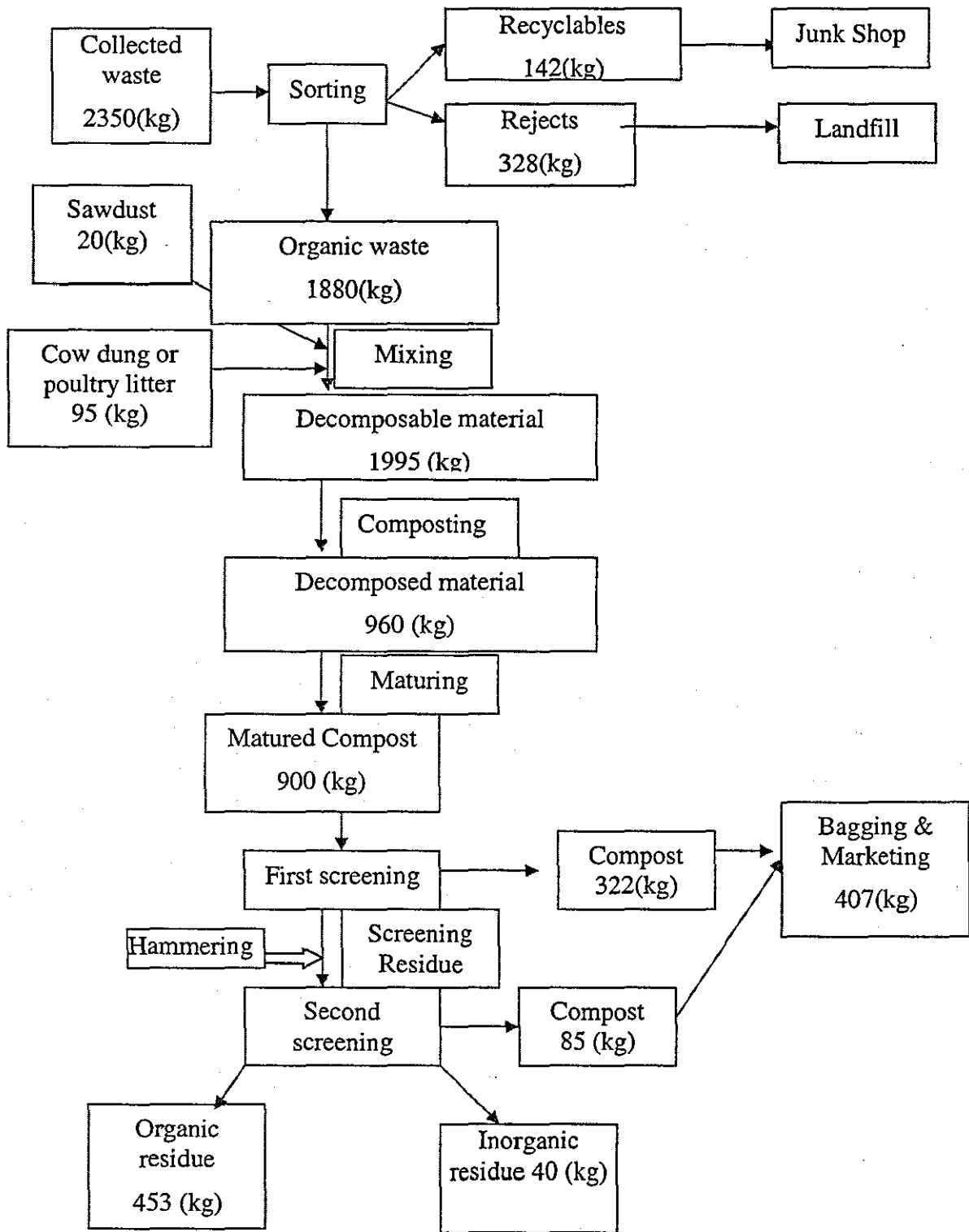
b) Maturation period: 5-10 days

- c) Temperature in the stack: 38-40 °C
- d) No. of workers involved in screening: 3
- e) Time record for first screening: 2 hrs/day [Normally 1 or 2 days interval this operation is taken place]
- f) Time record for second screening: 2 hrs/day [Normally 1 or 2 days interval this operation is taken place]
- g) Time record for further screening: 3 hrs/day [This operation is taken place 2-3 days interval]
- h) Size of the screen: First Screen size 1x1 cm² and 2nd Screen size 4x4 mm².

6. Bagging (Packaging)

- a) Size of the bag: 1 kg (7.5"x11.5"), 2 kg (10.5"x13.5"), 10kg, 20 kg
- b) No. of workers: 3
- c) Time required for bagging: 1,2 kg bag: 1 @1.5 min. 10,20 kg bag: @4 min
(with measurement)

Material flow Diagram of the Composting Process



Basic data on Composting Process (Data supplied by the Plant Operators)

Plant Name: Sobujsona Compost Plant- PRISM

Plant No-02, Khalishpur Kabarkhana Road, Khulna

1.For Collection

- a) Collection Area: Ward No. 10,7,11 (Partial Coverage)
- b) No of household covered: 900-1000 (Waste received from 700-800)
- c) No. and size of the van engaged: 4 Nos. L: 54", W: 34", Ht: 29"
- d) Year of manufacturing of vans: 2002
- e) Cost of manufacturing of the vans: 4@8,000TK
- f) Repair cost of vans: 4@200Tk/month
- g) Estimated Life of the Van: 4-5 Yrs
- h) No. of workers involved: 16 [Worker and Guard: 3, Plant Supervisor: 1, Van puller: 6@1, Van Helper 6@1]
- i) Time departure from the plant: One van at 11.45 am, and Rest Three vans 2.30-3.30 pm
- j) Distance of first household from the plant: 50 Meter
- k) Distance of last household from the plant: 2.00 Km
- l) Time of arrival at the plant: One van at 11.15 am and rest three vans 2:00-3:00PM
- m) No. of trips per van: 2 vans: Single Trip, 2 vans: give single trip one day and next day double trip. except holiday)
- n) Amount of waste collected by the van: 150-170 kg/day
- o) Seasonal variation of waste: Summer (Max), winter (Min) Spring (Mid) Autumn (Mid)
- p) Collection fees: 5Tk/HH (40-50 family), Remaining TK 10 Per household, Total fees: TK 7000-8000
- q) Salary of the workers: Worker: 2@1200Tk, Worker cum guard: 1@1500Tk, Vanpuller 6@1600TK, Van Helper: 6@ 500TK, Supervisor: 1@2800TK
- r) Any other income of the workers: workers 3@50-40TK/Month, Van puller4@350-450/Month

s) Type and materials of the waste bags of containers used by the households:

Plastic bin and bucket (Made up of Tin)

t) Size and number of bags/ containers: large/ medium/ small: 50 Liter water holding capacity container 12 nos, 8 Nos plastic container capacity 30 Liter. Total 20 Nos

u) Average generation of waste per household: 1-1.5 kg, In Slums 0.5-1.0kg

v) Road Condition: pavement (Good/ bad): Not Bad (Medium)

w) Traffic congestion: Yes/ No: No

Same workers and in same numbers are involved in sorting, piling, turning, screening and a part of workers (2/3) for packaging and storing.

2 *Sorting*

a) No. of workers involved: 3 Nos.

b) Time starts for sorting: 11:30PM (for the 1st van and within 20 min sorting can be completed) and for the remaining vans sorting start at 2:30 Pm

c) Time ends for sorting: 4:45PM

d) Amount of organic matters: 450-550 Kg/day, About 80% of Total Raw Waste

e) Amount of rejects: 100-200 Kg/Day,

f) Amount of recyclable: 650-750 KG/Month [Paper, Cardboard, Coconut Shell, Wood, Plastic Bottle etc]

g) Income from recyclable: workers 3@50 TK/Month, (Van puller4@350-450/Month)

3. *Piling or loading of Waste*

a) No. and size of aerators/ Box: Bamboo 13 Nos.(8'),

b) No. of workers involved: 3 Nos.

c) Starting time for piling: 12:00 N

d) Ending time: 5:00 PM

e) Length and height of the pile everyday: 8'-1. 25'

f) Temperature in the pile: 40⁰C

g) Cost of manufacturing of aerators or box: Bamboo @300Tk,

4. *Turning (Required for windrow aerated system)*

a) No. of workers involved: 3 Nos.

b) Starting time: 9:00 AM

c) Ending time: 11:00 AM

d) Temperature in the pile: <55 ⁰C

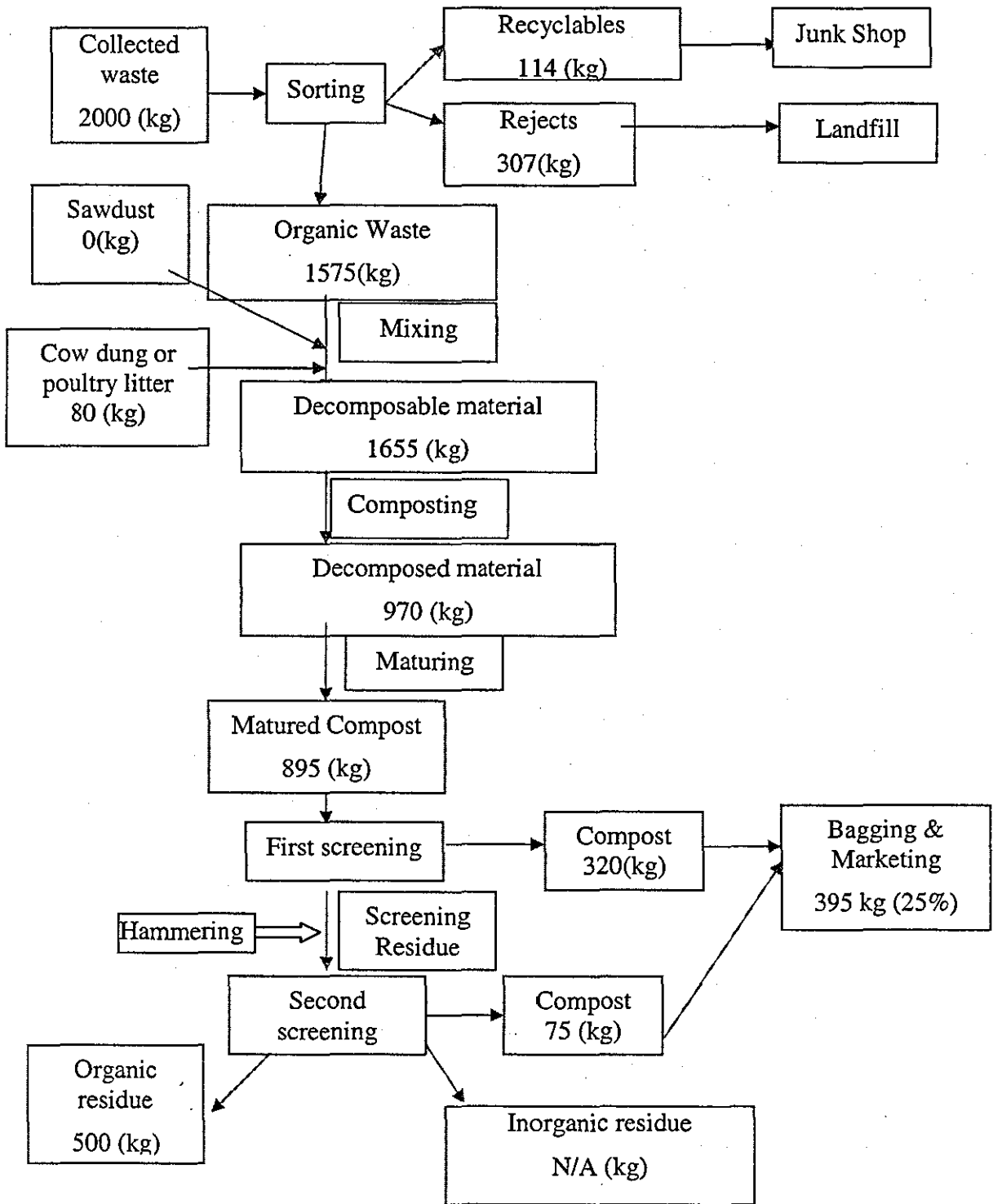
5 Screening

- a) Composting (decomposition) period: 45-60 days
- b) Maturation period: 3-5 days
- c) Temperature in the stack: 38-40 °C
- d) No. of workers involved in screening: 3
- e) Time record for first screening: 2 hrs/day [Normally 1 or 2 days interval this operation is taken place]
- f) Time record for second screening: 2 hrs/day [Normally 1 or 2 days interval this operation is taken place]
- g) Time record for further screening: 3 hrs/day [This operation is taken place 2-3 days interval]
- h) Size of the screen: First Screen size 1x1 cm² and Last Screen size 4x4 mm².

6 Bagging (Packaging)

- a) Size of the bag: 1 kg (7.5"x11.5"), 2 kg (10.5"x13.5"), 10kg, 20 kg
- b) No. of workers: 3
- c) Time required for bagging: 1,2 kg bag: 1 @1.5 min. 10,20 kg bag: @4 Min (with measurement) and @1(without measurement)

Material flow Diagram of the Composting Process



Basic data on Composting Process (Data supplied by the Plant operator)

*Plant Name: Sylhet partnership company
Sylhet*

1. For Collection

- a) Collection Area: 2 Wards
- b) No of household covered: 2700 households, 2000 business establishments, 5 markets
- c) No. and Size of the van engaged: 4, 40 cu.ft
- d) Year of Manufacturing of Vans: 2002
- e) Cost of Manufacturing of the Vans: 8500TK
- f) Repair Cost of Vans: 250 Tk/year
- g) Estimated Life of the Van: 5 Yrs
- h) No. Of collectors involved: 8
- i) Time departure from the plant: 11 AM
- j) Distance of first household from the plant: 1 KM
- k) Distance of last household from the plant: 2.5-3.5 KM
- l) Time of arrival at the plant: 2 PM
- m) No. of trips per van: 2
- n) Amount of waste collected by the van: 40 cu.ft
- o) Seasonal variation of waste: Summer , winter
- p) Collection fees: TK 15-25 Per household, Total fees: TK56000/month, from households Tk.16000, from business establishment Tk.40000
- q) Salary of the workers: Van driver and helper 8 @2500 TK./month, Plant worker 8@1500 Tk./month , 1 plant supervisor Tk. 5000/month
- r) Any other income of the workers: Sale from inorganic recyclables
- s) Type and materials of the waste bags of containers used by the households: Plastic Bucket, wooden basket
- t) Size and number of bags/ containers: large/ medium/ small: 20 Liter water holding Capacity.
- u) Average generation of waste per household: 2- 2.5 kg/day
- v) Road Condition: pavement (Good/ bad): Moderate
- w) Traffic congestion: Yes/ No: Yes

2. *Sorting*

- a) No. of workers involved:4 Nos
- b) Time starts for sorting: 2:00 PM
- c) Time ends for sorting: 6:00 PM
- d) Amount of organic matters: 2400 Kg/day
- e) Amount of rejects: 336 kg
- f) Amount of recyclable:145kg
- g) Income from recyclable:Tk.900/month

3. *Piling or loading of Waste*

- a) No. and size of aerators/ Box:
 No of Box - 8 [Size L- 19ft, W- 5 ft, H-5.5 ft]
- b) No. of workers involved:4 Nos
- c) Starting time for piling: 3:00 PM
- d) Ending time: 6:00 PM
- e) Length and height of the pile everyday: 19 ft* 1 ft
- f) Temperature in the pile: High 70⁰C, Low 40⁰ C
- g) Cost of manufacturing of box: Tk.8000

4. *Turning (Required for windrow aerated system)*

For Box – No turning

- a) No. of workers involved:
- b) Starting time:
- c) Ending time:
- d) No. of turning in a batch (Avg.)
- e) Temp. in the pile

5. *Maturation & Screening*

- a) Composting (decomposition) period: 45 days
- b) Maturation period: 10 days
- c) Temperature in the stack:55⁰C
- d) No. of workers involved in screening:4
 - First screening:
 - Second screening:
 - Third screening:
- e) Time record for first screening: 3 man-hour (output 250 kg)

- f) Time record for second screening: 2.5 man-hour(output 180kg)
- g) Time record for third screening: 1.5 man-hour(output 50 kg)
- h) Size of the screen: 8 mm sieve size (5ft * 3 ft)

6. Bagging (Packaging)

- a) Size of the bag: 50 kg
- b) No. of workers:4
- c) Time required for bagging: 40 kg bag/7 min

APPENDIX B1

Questionnaire for Community household Survey

Name of the surveyor:

Date of survey:

Name of the area:

[This data will be fully utilised for academic research. Your cooperation and neutrality in providing data is highly required. All information obtained will be treated confidential]

[*** Please put tick \checkmark mark on one or more boxes if needed]

1. Name of the household :
2. Address :
3. Education :
4. Occupation (Both for husband and wife if applicable):

Husband

Government service (if possible nature)

Business

Private service

Others (.....)

Wife

Government service (if possible nature)

Business

Private service

Others (.....)

5. Household size (family members) :
6. Household monthly income (gross) :
7. Distance of the house from the composting plant [To be recorded by the surveyor]
8. Who works in your kitchen?
 - House lord
 - House wife
 - Both house lord and housewife

- Maid servant
- Maid servant and House wife
- Others (specify.....)

9. How much waste do you generate everyday?

- < ½ kg ½ kg 1 kg 1 ½ kg 2 kg >2 Kg (specify

10. Will you separate your waste if a source-separation system is introduced with the primary waste collection service?

- Yes No

11. If Yes, how will you prefer to separating waste? (Please define)

- Wet + Dry
- Dry
- Wet + Dry +Hazardous

12. If No, why you will not separate waste? (Please define)

- Problem of keeping segregated waste in kitchen
- Lack of knowledge
- Put extra time and effort
- Other reasons (specify.....)

13. Do you know how your wastes are being disposed?

- Yes No

14. If yes, do you think composting is good for your community environment?

- Yes No Partly

15. How, you have informed about the project?

- Leaflet Meetings or workshops NGO worker Community leader

16. What benefits are you getting from composting? (If needed √ more than one)

- Fewer waste on the street
- No overflow of waste from dustbins
- Less mosquitoes and flies breeding

- No odour
- others (Please specify

17. What are the negative impacts of composting in your community? (If needed √ more than one)

- Bad smell
- Insect and vermin infestation
- Local hazard or nuisance
- others (specify.....)

18. Are you facing odour problem from the plant?

- More frequent
- Less frequent
- No smell

19. Have you been consulted before the installation of the plant in your community ?

- Yes
- No

20. Have you visited composting plant?

- Yes
- No

21. Have you purchased or used compost of the plant in your garden?

- Yes
- No

22. Do you think this type of community composting plant can solve the waste problem of the city?

- Yes
- No
- Partly

23. Will you pay for the composting activity?

- Yes
- No

24. If yes, why do you want to pay?

- Good for health and environment of the community
- Community responsibility
- Help the poor

25. If No, why are you not interested to pay for composting?

- Municipal responsibility
- Paying taxes for waste management
- Not community responsibility

[Thanks for your co-operation]

APPENDIX-B2

Questionnaire for Community household Survey for Barrel type composting in slums

Name of the surveyor:

Date of survey:

Name of the area:

[This data will be fully utilised for academic research. Your cooperation and neutrality in providing data is highly required. All information sources will be treated confidentiality maintained]

[*** Please put tick \checkmark mark on one or more boxes if needed]

1. Name of the household:

2. Male Female

3. Nature of the house Tenant Owner

4. If tenant, rent of the house:

5. Size of the house (Please record by the surveyor) :

6. What is your profession :

Service Rickshaw puller Daily labour

Hawker/ ferryman Small business Housewife

Unemployed Others(if specify.....)

7. Total monthly income :

8. Members in your family :

9. How long you have been living in this slum :

10. What are the problems , do you find in this slum ? [Please rank in scale

1 to 5, 1= more 5= least]

Poor drainage (water logging) Poor sanitation (open latrine)

Solid waste disposal Lack of space (Dense habitant)

Water shortage Others (Please specify)

11. Where you put your waste before the barrels were introduced ?

At the open place At the municipal bins

At the road side Beside your house

At a common place in the slum Any other way (Please specify)

12. Distance of the barrel from the households (Please record by the surveyor) Green (Organic)..... Yellow (Inorganic).....

13. Location of the barrel (Please record by asking the households)

Green (Organic)

Near the toilet At the passage Over the drain

In front of the house At the back of the house

Any other location (Please specify)

Yellow (Inorganic)

Near the toilet At the passage Over the drain

In front of the house At the back of the house

Any other location (Please specify)

14. Who has selected the location of the barrels ?

NGO Leaders of the Slums Yourself

Combined Any other way (Please specify)

15. How many members sharing one green (organic) barrel ?

16. How many members sharing one yellow (inorganic) barrel ?

17. How long you are participating in the composting activities ?

18. What are the problems are you facing (If required put tick \sqrt more than one)

Smell Flies/mosquitoes/insects/rodents Space constraints

External intervention Any other problem (Please specify)

19. Why you are putting your wastes in barrels ? [Please rank in scale 1 to 5, 1= more prominent..... 5 = Less prominent]

Health Environment Income

No waste management service Other reasons (Please specify

.....)

20. What are the awareness programmes you participated [If required put tick \sqrt more than one]?

Rally Meeting Cleanliness day

Video film others (Please specify)

21. Are there other NGOs working in the Slums?

Yes

No

22. If Yes, what are their programmes? [If required put tick ✓ more than one]

Waste management Water supply Sanitation (Toilet construction)
Health & Family planning Credit programme

Any other (Please specify)

23. How long it will take to fill the green barrels?

24. How much money you got?

25. How many months interval you got money?

26. Do you want to pay for barrels?

Yes

No

27. Why you are not interested to pay for barrels?

Uncertainty of settlement

May be stolen

Donor may support

[Thanks for your co-operation]

APPENDIX-B3

Questionnaire for Community household Survey at Baily Road

Name of the surveyor:

Date of survey:

Name of the area:

[This data will be fully utilised for academic research. Your cooperation and neutrality in providing data is highly required. All confidentiality of the data sources will be maintained.]

[** Please put tick \checkmark mark on one or more boxes if needed]

1. Name of the household :

2. Address :

3. Do you know waste is collected from your flat?

Yes No Not regular

4. What is doing with your waste?

Dumping in the nearby dustbin Making compost

5. Do you know about the compost plant behind your building?

Yes No

6. If yes, when it was constructed?

1 year 2 years 3 years more than 3 years

7. Are you consulted before construction?

Yes No

8. Have you visited the composting plant?

Yes No

9. Have you used or buy compost?

Yes No

10. Do you know the compost plant is now closed?

Yes No

11. Had you raised any objection about the plant?

Yes No

12. What was the objection?

Smell Nuisance or hazard

Mosquito or flies infestation Others (.....)

13. If the causes for objection are minimised, do the compost plant can operate again?

Yes No

14. What is your opinion about the plant?

Demolition Shifting No need in the community

Others (.....)

15. What is your opinion this type of plant is good for environment?

Yes No

16. Who is responsible for your waste management?

City corporation Public works department (PWD)

Community yourself City corporation and community

17. Do you pay fees to PWD or City Corporation for waste management?

Yes No

18. How much you are paying?

..... Tk./month

19. Do you want to pay City Corporation for waste management?

Yes No

20. Do you know a NGO is collecting your waste?

Yes No

21. If the NGO stops the waste collection, what you do with your waste?

Tell PWD to arrange Dump in near by dustbin

Arrange community collection by yourself

[Thanks for your co-operation]

APPENDIX-B4

Questionnaire for Compost End-users (Crop cultivators and Vegetable growers) Survey

Name of the surveyor:

Date of survey:

Name of the area:

[This data will be fully utilised for research. Your cooperation and neutrality in providing data is highly required]

[*** Please put tick \checkmark mark on one or more boxes if needed]

1. Name of the grower:

2. Distance from Dhaka City (Please record by surveyor):

3. Land ownership pattern:

- Owner Shared cropper Leased /Rented cropper
 Others (Please specify

4. Area of land under cultivation: Decimal

5. Types of crops cultivated?

- Rice Wheat Maize Flowers
 Fruits Vegetables Jute Others (please specify....)

6. Amounts of land under fertiliser use including composting?

- Decimal or % (percent).

7. Frequency of fertiliser use in a year (chemical or compost)

- One time Two times More than two (Please specify

8. Present use of fertilisers in your land?

Type

Quantity used

Cost

Chemical fertilisers-

Compost

Others (please specify)

i)

ii)

9. What kind of chemical fertilisers do you use?

Type of chemical fertilisers Quantity used Cost

Urea

Phosphate

Potash

Others (Please specify)

i) Mixed fertilisers

ii) Zinc

10. From where you are getting the fertilisers? (Please specify distance)

Dealer Open market

Others (Please specify)

11. What type of compost or organic fertilisers is used?

Crop residue Animal manure Green manure

Waste derived compost Chemical and organic (Mixed)

Others (Please specify)

Do not use [No need to reply 12, 13, 14, 15, 16, 17]

12. If you use, how much amount do you use?

.....Kg or Ton

13. Where do you get the compost?

Self made Market Dealer

Compost plant Others (Please specify

14. When you use the compost?

Before cultivation During cultivation

During crop grows Others (please specify.....)

15. In what price do you buy compost? Tk./Kg

16. Why you are using compost?

Getting more crops Increase soil fertility

Softness of soil Less water requirement

Less disease from insect Less requirement of chemical fertilisers

Fresh vegetables Good taste

Others (Please specify.....)

17. Are you satisfied with compost use?

- Yes No

18. What are the problems you encounter in compost use?

- Presence of contaminants Plant growth is slow
 Expenditure is more
 Others (Please specify)

19. How you got the information?

- Television Radio Newspaper
 Leaflet /Poster Sales man Dealers
 From agriculture department Demonstration plot
 Others (Please specify)

20. a. How much amount you have used?

..... Kg/ month or Kg / Year

b. How you got the compost?

- From market From Dealer From Plant
 Other sources (Please specify)

c. How much you paid? Tk./Kg

21. How much amount do you need?

..... Kg / month or Kg /year

22. How much you want to pay for the compost?

Tk./Kg

23. Nature of the soil in your land

- Loamy Clayey Sandy
 Sandy loam Others (Please specify.....)

24. Type of land

- Plain Hilly Flood plain
 Others (please specify.....)

[Thanks for your co-operation]

APPENDIX-B5

Questionnaire survey for Peri-urban farmers

Name of the surveyor:

Date of survey:

Name of the area:

[This data will be fully utilised for academic research. Your cooperation and neutrality in providing data is highly required]

[*** Please put tick \sqrt mark on one or more boxes if needed]

1. Name of the grower:

2. Distance from Dhaka City (Please record by surveyor):

3. Land ownership pattern:

Owner Shared cropper Leased /Rented cropper

Others (Please specify

4. Area of land under cultivation: Decimal

5. Types of crops cultivated?

Rice Wheat Maize Flowers

Fruits Vegetables Jute Others (please specify....)

6. Amounts of land under fertiliser use including composting?

Decimal or % (percent).

7. Frequency of fertiliser use in a year (chemical or compost)

One time Two times More than two (Please specify

8. Present use of fertilisers in your land?

Type

Quantity used

Cost

Chemical fertilisers-

Compost

Others (please specify)

9. What kind of chemical fertilisers do you use?

Type of chemical fertilisers

Quantity used

Cost

Urea

Phosphate

Potash

Others (Please specify)

i) Mixed fertilisers

ii) Zinc

10. From where you are getting the fertilisers? (Please specify distance)

Dealer Open market

Others (Please specify)

11. Do you use compost?

Yes No

12. If Yes, why you are using compost?

Getting more crops

Increase soil fertility

Softness of soil

Less water requirement

Less disease from insect

Less requirement of chemical fertilisers

Fresh vegetables

Good taste

Others (Please specify.....)

13. What type of compost or organic fertilisers is used?

Crop residue

Animal manure

Green manure

Waste derived compost

Chemical and organic (Mixed)

Others (Please specify)

14. How much amount do you use?

.....Kg or Ton

15. Where do you get the compost?

Self made

Market

Dealer

Compost plant

Others (Please specify

16. When you use the compost?

Before cultivation

During cultivation

During crop grows

Others (please specify.....)

17. What price do you buy compost? Tk./Kg

18. Do you have idea about waste-derived compost?

Yes

No

19. Are you interested in using waste-derived compost?

- Yes No

20. Why you are not willing to use waste derived compost?

- No knowledge or information Concern about pollution of soil
 Availability of local organic materials No confidence on the product

21. Nature of the soil in your land

- Loamy Clayey Sandy
 Sandy loam Others (Please specify.....)

22. Type of land

- Plain Hilly Flood plain
 Others (please specify.....)

[Thanks for your co-operation]

APPENDIX-B6

Questionnaire for Nursery Survey

Name of the surveyor :

Date of survey :

Name of the area :

[This data will be fully utilised for research. Your cooperation and neutrality in providing data is highly required]

[*** Please put tick \checkmark mark on one or more boxes if needed]

1. Name of the Nursery :

2. Area of the nursery (Please record by surveyor) :

3. Land ownership pattern :

- Self Rent Government land
 Private land Others (Please specify)

4. Types of plant grow in the nursery ?

- Fruit Flower Cactus forest sapling
 Beautification plants Others (please specify....)

5. Present use of fertilisers in your Nursery ?

<u>Type</u>	<u>Quantity used</u>	<u>Cost</u>
Chemical fertilisers-		
Compost		
Others (please specify)		
i)		
ii)		

6. From where you are getting the fertilisers? (Please specify)

Dealer Open market

Others (Please specify)

i)

ii)

7. What type of compost or organic fertilisers do you use?

Animal manure Green manure

Waste derived compost Chemical and organic (Mixed)

Others (Please specify)

Do not use [No need to reply 8,9,10,11]

8. Where do you get the compost ?

Self made Market Dealer

Compost plant

Others (Please specify)

i)

ii)

9. In what price do you buy compost ? Tk./Kg

10. What benefits do you get from using compost ?

Rapid growth of plants Less water requirement

Looks strong Less disease from insect

Less requirement of chemical fertilisers Less costly

Others (Please specify.....)

i)

ii)

11. What are the problems in using compost ?

No problem Plant die

More expenditure than plant growth

Others (Please specify)

i)

ii)

12. If you don't use compost, why?

- No need of organic matter in soil
- Non-availability or Not regular supply
- Expensive
- Poor quality (Odour and contaminants)
- Others (please specify)
 - i)
 - ii)

13. Do you have idea about compost from city waste ?

- Yes
- No [No need to answer 14]

14. If yes, how you got the information?

- Television
- Radio
- Newspaper
- Leaflet /Poster
- Sales man
- Dealers
- From agriculture department
- Demonstration plot
- Others (Please specify)
 - i)
 - ii)

15. Have you used waste derived compost in your nursery ?

- Yes
- No [No need to answer 16]

16. If Yes

a. How much amount you have used ?

..... Kg/ month or Kg / Year

b. How you got the compost?

- From market
- From Dealer
- From Plant
- Other sources (Please specify)

c. How much you paid ? Tk./Kg

17. Are you interested in using compost?

- Yes
- No

18. Why you are not willing to use waste derived compost?

- No confidence on the product
- Plant may die

- Expensive
- Slow plant growth
- Infestation of insects or pests.

19. How much amount do you need for your nursery ?

..... Kg / month or Kg /year

20. How much do you want to pay for the compost ?

Tk./Kg

21. What other things do you sell in your nursery?

- Flower Pot Soil Compost
- Insecticides Others (Please specify.....)

[Thanks for your co-operation]

APPENDIX-C

Structured Interview with Compost Dealer

[This data will be fully utilised for research. Your cooperation and neutrality in providing data is highly required]

Name and Address :

Date of Interview :

1. How long you are engaged in compost/ organic fertiliser business ?
2. How many times you took supply/ sold compost ?
3. Do you have any other business along with compost sale ?
4. How much the users pay for compost ?
..... Tk/Kg Tk/ Bag(Kg)
5. Do you sell any other compost or organic fertiliser ? If yes, in what price ?
6. What problem do you face in selling compost ? Please Explain.
7. What is your opinion about quality, price or supply of compost ?
 - i)
 - ii)
 - iii)
8. Is there any complain from the compost users ?
9. What media you have used for publicity of compost ?

Leaflet	Poster	Personal communication
Advertisement		Demonstration

10. What is the present estimated demand ? How much do you supply ?
11. In which seasons the demand is high ? Is there demand for whole year?
12. Do you have any demonstration plot for encouraging the users ? If you made demonstration , whether the sale increased?
13. Which way you sell compost (e.g sell compost with chemical fertilisers, less price or free, credit)
- 14 .Whether the chemical fertiliser sale has reduced due to compost sale ?
15. Have you taken any help from agriculture department (Block supervisor or any other assistance)for compost sale ?
16. How much amount of fertilisers do you sell in one year ?

Type of fertilisers

Quantity sale

Urea

Phosphate (TSP)

Potash (MP)

Others (Please specify)

iii)

iv)

Compost

17. Numbers of farmers buy fertilisers in one year

Chemical fertilisers

Compost

[Thanks for your co-operation]

APPENDIX- D

Trnascript for interview with Iftekhar Enayetullah, Director Waste Concern

1. How much compost does your organisation produce? What is the present capacity? Does the present level of production meet the present demand for compost? How much you can supply and how often? Do the customers have to wait?

Ans: The present maximum capacity of 4 composting plants in Dhaka is 250-300 tons/year. The demand in the first year in 2000 was 200 ton. The present demand for compost is estimated at 15000 tons/year. We are able to sell between 300-400 tons/year. Map Agro takes the compost to their plant thrice a month.

2. What is the present use of your compost? What are the customers' wants and needs from compost? Can your product satisfy the needs? Is there any seasonal variation of demand?

Ans : Compost is used in all types of crops in Bangladesh. The product has been able to satisfy the needs of the farmers as evident from the growing demand of the product. For details contact ALPHA & MAP AGRO. The demand is consistent all around the year as Alpha is promoting enriched compost. However, our data shows that farmers demand more raw compost during the Rabi season.

3. What quality (nutrient value) does your compost offer to the customer? What benefits does it bring to the customer? Is their any adverse effect or complaints (glass, metal or plastic fragments) about the compost?

Ans : The nutrient value of compost N = 2.10% P₂O₅ = 4%; K₂O = 2.60%. The farmers are getting higher yield using the enriched compost between 30 to 50% per ha (scientific data available at our office). So far no complaints from farmers about the quality of compost as it monitored twice once at our plant and second time at Map Agro's Plant.

4. What are the customers' observations about the quality of compost? Can the product satisfy the wanting of the customer? What improvements the customers want to see in the compost?

Ans: Customers are satisfied with the quality of compost. They are asking for more compost. In order to fulfil the demand, Waste Concern has initiated the process of establishment of 200 tons compost plant with annual production capacity of 12000 tons. This plant is being established on BOO basis. Negotiation is under process with financier. It is not going to be established on grants.

5. How you measure the standards of the compost? Is there any national or agricultural guideline for standards?

Ans: Waste Concern, as per the contract has to maintain a minimum level of NPK and moisture content for the compost being sold to Map & Alpha Agro. At present, in Bangladesh there is no compost standard. However, Waste Concern has obtained a clearance in writing from MoA (Ministry of Agriculture) to maintain in minimum percent of NPKS in the compost. The MOA notification is as follows:

"Nutrient concentration and other ingredients of the compost mentioned in your application should always maintain the right quality (N- 1.44%, P-0.96%, K-1.6%, organic material-15.23%, moisture content-22.59%). The fertilizer committee of the government may visit your factory in case of necessity and analyse the compost to make sure that the compost reaches your standards.(MoA Order Dated Feb 5, 2001)"

6. Does your compost comply with the standards? What measures need to be taken to ensure quality? Do you have any plan to improve the quality and how? How you monitor the quality of the compost? How often you test the quality?

Ans: Waste Concern's compost is in full compliance of standards set by MOA. Random test of each batch of compost is being done at DU(Dhaka University) and SRDI (Soil Resources Development Institute) Lab. Waste Concern is now using EM (Effective microorganism) to increase the micro-nutrient content as well as to maintain aerobic condition through out the composting process. Recently, Waste Concern has

initiated the process to establish its own environmental and soil lab at Banani, Dhaka. This lab is being set-up keeping in mind the growing number of composting plants being set-up in the country between 2002 and 2004. Moreover, as different NGOs and private sectors are keen to establish composting units using Waste Concerns model, Waste Concern working to become the regulators to ensure the compost quality, as Waste Concern has already earned credibility at both home and abroad.

7. Do you have any demonstration plot? What is the customers' impression? Is there any impact in buying compost?

Ans : Demonstration plots have been set-up in different AEZ of the country under the SEMP. The main objective of the demo plots are two folds:

a) To monitor the change in yield using compost, enriched compost and chemical fertilizer.

b) To monitor the change in micro-nutrient content as well as organic matter content in soil.

8. Have you applied or demonstrated compost in farmers land? What reactions the farmers have? Are the yields better? What observations have you monitored?

Ans : Yes. The parameters mentioned in Ans 7 are monitored. In terms of yield result shows that use of enriched compost increases yield between 30-50%

9. Have you tried any diversified product?

Yes. We are now going for production of enriched granular compost in partnership with Map.

10. How does your compost sale (bag or bulk)? Is the packaging convenient to customer for handling or storage?

Ans: In 40 Kg bag. Yes the package is convenient to farmers.

11. Is the packaging informative to pay attraction to customers?

Ans. Yes. The nutrient contents of compost are inscribed in the package

12. Is your compost branded and how it has been branded?

Ans. It is sold in the market using the brand name Diamond Organic Fertilizer.

13. What prices does the customer pay for the compost? Is the product price same /lower/expensive than the competing products? What are the competing products?

Ans. Compost is sold at price of Tk. 2.50/kg by WC from the plants. However Map & Alpha agro can tell you about the price they sell to farmers.

14. Please explain about marketing of compost.

Ans. A good market for compost exists in Bangladesh. Waste Concern assists the communities to sell its compost to a number of outlets like fertilizer marketing companies and nurseries. Waste Concern is at present selling its compost at a price ranging from Tk. 2.5 to Tk. 5.0 per kg (US\$ 0.047-0.092). The quality of compost is monitored in the laboratory of Soil Resources Development Institute under the Government of Bangladesh. The comparative nutrient concentration of compost available in the international market and that of produced by Waste Concern in Dhaka.

Comparative Analysis of Nutrient Concentration in Solid Waste Compost

Nutrient concentration (values in %, except pH)	Compost produced		
	By Original Indonesian Technique	Available in Local Market	By Waste Concern
Nitrogen (N)	1.4	1.1	2.10
Phosphorous (P)	0.36	0.4	4.0
Potassium (K)	0.66	0.50	2.60
pH	7.8	7.5	7.0

Source: Waste Concern

Waste Concern is also promoting sale of nutrient enriched compost. Waste Concern has signed partnership agreement with Map Agro Ltd., a fertilizer marketing company to sell all the compost produced in different community based composting plants. This company purchases bulk of the compost produced by Waste Concern, enriches it, and markets the product. Map Agro has established Nutrient Enriched Organic Manure Production Plant at Uttara, Dhaka, where they enrich the compost produced by Waste Concern. Waste Concern sells compost to Map Agro at Tk. 2.5 (US\$ 0.046) per kg. However, Map Agro, sells the enriched compost in the market at a price ranging between Tk.6 to Tk. 8 per kg (US\$ 0.11 to 0.148).

Transcript for interview with Soheli Faruqui, Chief Conservancy Officer, Dhaka City Corporation

Ques.1. Describe the waste management situation in Dhaka city.

Ans. According to the waste management ordinance of Dhaka City Corporation, residents need to take responsibility to bring their waste to DCC waste collection points where DCC's responsibility covers waste collection and transportation from DCC's dustbins/ containers to final disposal sites. Now, in most parts of the city, NGOs/CBOs are providing the house to house waste collection services by rickshaw vans and put the waste in the containers kept in the main roads. There are no guidelines or rules for door to door waste collection or other related activities of waste management at the local level. In the year 2002, DCC introduced a system of permission for streamlining NGOs/ CBOs waste collection services, and the organisations that have capacity to provide a ward level services or a part under some conditions.

So far DCC has given permissions to 47 NGOs to work in 57 areas covering 52 wards out of 90 wards. Waste collection and disposal of two zones has given to private companies.

Ques.2 What are the problems facing the city with disposal of waste?

Ans. Waste is increasing and at this stage we are operating one disposal site in the south-east part of the city with an average travel distance of 6 to 7 km. The disposal site will be filled up within a year or two. We are looking for four disposal sites at each corner of the city and the land procurement is under progress. We are positively thinking of waste reduction and treatment options to relieve the burden of transportation and disposal. We have already invited Expression of Interest from the investors on a BOOT basis.

Ques.3 What are the treatment options do you think better for managing your waste ?

Ans. Waste nature is gradually changing with our life-style. We are now collecting both domestic and commercial waste, which is a heterogenic mixture of waste. Recycling of inorganic waste by the informal sector is running in a good shape. The organic portion of waste has a potential for composting and at the same time recovery of energy has good prospect from our waste.

Ques.4 Do you have idea about the conversion of waste into organic fertiliser or compost?

Ans. Yes, some activities of composting from waste are going on in a very small-scale. These small initiatives are encouraging but in a mega-city with thousands ton of waste, we should think of scaling up of the projects in a larger scale.

Ques.5 Have you visited the compost plant?

Ans. I have not got scope to visit compost plants in Dhaka but I know the activities from presentation in the seminars and meetings.

Ques.6 What is your impression about this project?

Ans. This project is running well in the community but involvement of city corporation is needed for dissemination of ideas for its future replication in city scale.

Ques.7 What is your idea about the sustainability of the project?

Ans. So far I gather the projects are donor-assisted. I am not sure what will be the fate of these projects in future! Whether the community could be able to handle this type of project! For sustaining the project, the initiators should develop a mechanism to transfer its activity to the community.

Ques. 8. What benefits the community or locality has got from the composting project?

Ans. I have not yet visited the project site but what I feel the community is much cleaner than before as door-to-door collection is a part of this project.

Ques.9 What benefits the city corporation has got from this type of plant?

Ans. As some amount of wastes are being treated at the neighbourhood, so this type of plant reduces transportation and disposal cost. But the amount is so insignificant that it did not have any impact in our waste management system.

Ques. 10. How City Corporation can extend support to this type of project?

Ans. We need to know the prospect of the project in the cities; if it sounds good, we can join in a partnership or operate by own.

Ques.11 Do you think that this type of community based projects can solve the waste problem in the city?

Ans. The problem of city is large. These community initiatives may contribute partly to the city waste problem.

Ques. 12 Do you think that compost has a demand?

Ans. Yes, compost should have demand. Compost from waste is very new; it needs extensive publicity and demonstration for marketing.

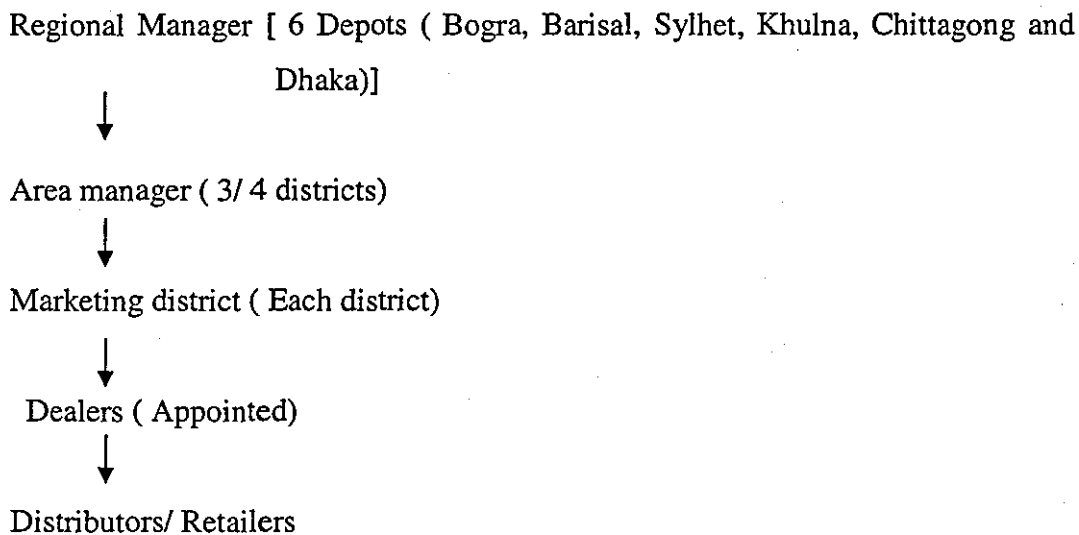
Ques.13 What are the factors need to be considered for marketing the product?

Ans. People should accept the product first from its appearance and effectiveness. Price must be cheaper than chemical fertilisers or other compost and its regular supply.

Transcript for interview with Md. Rafiqul Islam, Research and Product Manager of Alpha Agro Ltd.

Ques.1 Describe your company and your marketing network.

Ans. Alpha-Agro Ltd. is a large fertiliser, pesticide and seed distribution company in Bangladesh having marketing networks in 64 districts.



Ques.2 When you have started the compost distribution business? How you are selling the compost?

Ans. We have started the enriched compost marketing from year 2000 using our existing pesticide distribution network. We are buying the enriched compost from Map- agro at the price of Tk. 10 and selling it by Tk. 12 adding the avg. transportation cost (Tk. 1.0 to 1.5/kg).

Ques. 3 What are the alternative organic fertilisers or composts in the market? Is the enriched compost price same /lower/higher than the competing products?

Ans. The alternative organic fertilisers are mostly self-made product by the cultivators. They are not competitive to the enriched compost. The dealers are selling enriched compost on a push sale basis to recognise the product to the farmers. Mainly,

the vegetable growers are our customers. Once they use it, they want for more. But the supply is irregular; we can not fulfil their demand which discourage the farmers. As they are our regular pesticide customers, we can keep them in our supply network. We are mainly experimenting and popularising the product in two districts namely Bogra and Barisal.

Ques.4 What promotional methods are you using to communicate the customers?

Ans. We have marketing officers in every district for our pesticide products, who communicate the product to the farmers through leaflets and verbal discussion. The quantity that we are selling is so small that at this stage we are not ready to spend money for promotional activities.

Ques.5 What are the problems do you experience in selling compost? What is your observation about the quality? Are you getting consistent quality and supply? What are the users general complain about the compost?

Ans. The main problem is the insufficient supply with the demand. We need to give lot of efforts to popularise the product. We try to test the product yearly, mainly the micro-nutrients and the organic matter. We have established a demonstration project at Rajendrapur, Dhaka, where we have got good yield. The goodwill of our company brings the customers. The customers have a very good impression about the product but they sometimes complain for sharp materials.

Ques. 6 Is your compost branded? What types of information are included in the package to pay attention of the customers?

Ans. Yes, the product we are selling in the brand name Dimond Organic fertiliser. We are selling it in 40 kg bag; the nutrient contents are mainly inscribed in the package and our marketing officers recommend the application dose.

