SECTION G

WASTE REDUCTION, RECYCLING AND INTERMEDIATE TREATMENT

THE STUDY ON SOLID WASTE MANAGEMENT IN NAIROBI CITY IN THE REPUBLIC OF KENYA

FINAL REPORT

SECTION G

WASTE REDUCTION, RECYCLING AND INTERMEDIATE TREATMENT

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WASTE REDUCTION, RECYCLING AND INTERMEDIATE TREATMENT

1. CASE STUDY ON COMMUNITY BASED SWM PROJECTS

1.1 Summary

It is estimated that less than 10% of the total waste generated by the City of Nairobi is collected by the Nairobi City Council (NCC). Following the deterioration of services by the Nairobi City Council, particularly in the ever mushrooming informal settlements (which have the highest population growth rate in the City), Community Based Solid Waste Management initiatives were started in 1992. The focus was on composting the organic fraction of waste.

Currently there are 15 groups involved in composting and other waste management activities, mainly concentrated in low income areas. Composting has the potential to be income generating, however, there are a number of constraints facing the community groups. The most important of these is land on which to carry out the activities.

This Chapter presents three case studies of community projects in composting. Two of them are successes to an extent, the third one highlights clearly how land tenure can constrain such a project.

The Karen Langata District Association is a pioneering lobby group with a membership of residents (mainly high income) of the Karen Langata area. Activities of the Association include lobbying and litigation on issues that are of concern to its members. A number of landmark court decisions in favour of the Association and a case being brought against the NCC (residents of the area do not have to pay service charges pending the outcome of the court case) has led to a rapid increase in membership of the Association and the emergence of similar groups throughout the City.

Recommendations are presented with a view to consolidating ways in which community based solid waste management can augment an overall solid waste management master plan for the City of Nairobi. These include: development of policy governing waste management at community level; planning for space to be set aside for waste management activities; a central agency to market compost; and the establishment of NCC liaison groups and regular communication with community groups and residents' associations.

1.2 Introduction

The Nairobi City Council has a statutory obligation to provide solid waste management services for the City of Nairobi. It is currently estimated that less than 10% of the total waste generated by the city is collected by the Nairobi City Council.

For a variety of reasons analysed in a number of reports (Makopa, 1996; Karuga, 1993; Geerts, 1996), the Nairobi City Council has failed in providing services to the community at large. Manifest are piles of refuse scattered throughout the city.

With a high population growth rate estimated to grow to between 3-4 million by the turn of the century, with 2-3 million people living in informal settlements (Makopa, 1996), the implication is that the Nairobi City Council will also need to expand and grow. In its current state without radical reform/management improvement, it is unlikely that NCC shall ever be able to cope with the demands of the city.

It is the purpose of this report to present four case studies on community based solid waste management, with a view to recommending ways in which a Community Waste Management Project (CWMP) can augment waste management proposals to be presented in a master plan for Nairobi's solid waste management, and to develop a model for community based solid waste management projects.

1.2.1 Background to Community Waste Management Initiatives in Nairobi

(1) Solid Waste Management at Community Level: Central Government and Nairobi City Council Policy

Policies to govern community based solid waste management (particularly for informal settlements) do not exist within the current policy framework.

Legislation and Nairobi City Council by-laws do exist, but are not enforced. It has been suggested that a review of the by-laws is required in order to streamline operations in solid waste management (Makopa, 1996).

(2) Informal Settlements in Nairobi

A study carried out in 1989 identified the main informal settlements in Nairobi (Matrix, 1989). These are shown in **Table G.1-1.**

It should be noted that:

(a) The list is not exhaustive, and many more informal settlements may have sprung up since the time of carrying out the study. New ones identified include: Lunga Lunga/Kwa Reuben and Kayaba (Makadara Division); Kuwinda (Langata Division); and Kiambio (Kasarani).

(b) Population growth rate in the city is highest in the informal settlements estimated at 10% per annum (Karuga, 1993). As a very course estimate, the population in the listed informal settlements could well have doubled within the space of the last 8 years.

(c) Informal settlements are usually neglected in all aspects of infrastructure including solid waste management.

Table G.1-1 Informal Settlements in the Seven Administrative Divisions of NCC

Name of settlement	Total area in hectares	Average no. of dwelling units per hectare	Population per unit	Estimated population of settlement
Makadara Division				
Mariguini	14.2	300	4	17,040
Express	16.8	300	4	20,160
Mukuru	54.4	300	4	65,280
Total	85.4			102,480
Langata Division				
Kibera	225.6	220	5	248,160
Mitumba	1.5	200	4	1,200
Bomas	2.1	200	4	1,680
Total	229.20			249,360
Kasarani				
Mathare	73.7	200	4	58,960
Korogocho/Kinyago	49.2	230	5	56,580
Thome	7.3	100	3	2,190
Njathini	8.75	100	3	2,625
Garba	13.75	160	3	4,125
Githurai	21.8	100	3	6,540
Kahawa	30.5	100	3	9,150
Kamai	9.95	100	3	2,985
Total	214.95			143,155
Dagoretti				
Ngando	12	100	5	6,000
Riruta	15	100	5	7,500
Kawandini	23	100	5	11,500
Kawangware Muslim	111	100	5	55,000
Kawangware Village	37	100	5	18,500
Kangemi	75	100	5	37,500
Dagoretti	14.5	100	5	7,250
Waithaka	41	100	5	20,500
Muturini	45	100	5	22,500
Total	373.5	100	5	186,250
Embakasi				
Maili Saba	39.7	100	3	11,910
Soweto	10.0	200	3	6,000
Kayole	23.3	200	3	13,980
Total	73			31,890
Pumwani				
Buru Buru Centre	4.5	140	3	1,890
Kitui @ }	10	250	4	10,000
PumwaniVillage }				
Total	14.5			11,890
Parklands				
Runda	11.5	100	3	3,450
Kitisuru	11.25	100	3	3,375
Spring Valley	1.67	100	3	501
Total	24.42			7,326

Source: *Matrix, 1989*

(3) Community Based Solid Waste Management Initiatives

In 1992 the Uvumbuzi Club (see **Section 7.5, Data Book 7**) initiated the idea of composting as a means of dealing with the organic fraction of solid waste

primarily from households (especially in low income areas, where these wastes were being dumped randomly). Uvumbuzi Club had two main objectives for the projects it organised:

(a) To start an initiative to clean the city, following the continued deterioration in services by the NCC; and

(b) To set up the projects as income generating projects, especially in low income areas.

Uvumbuzi Club facilitated 10 groups to form, of which only two have been operational to this date (Kuku Womens' Group, and Nyayo Market Mbolea Group). Uvumbuzi Club approached the Foundation for Sustainable Development in Africa, FSDA [see **Section 7.5, Data Book (1)**], which had expertise in organic farming and composting, to provide technical advice for composting in the context of organic wastes.

Since the pioneering groups set up by the Uvumbuzi Club in 1992, a number of other organisations (see **Table G.1-2**) have initiated self-help solid waste management projects in the city, although these mainly concentrate on composting. Recycling of inorganic wastes (such as glass, plastics, ferrous and other metals) also takes place but is widely carried out by private individuals, albeit on an informal basis in the city rather than community groups.

1.2.2 Brief Survey of Main Groups Involved in Community Based Solid Waste Management in Nairobi

(1) The Extent of Community Based Solid Waste Management Activity in the City of Nairobi

Presented in **Table G.1-2** is an estimate of the current extent of community based solid waste management activity in the City of Nairobi, and its distribution. The main *known* facilitators/organisations working in urban slums were surveyed; however, it is acknowledged that the list is not exhaustive, and there may be other groups that are not currently known.

Figure G.1-1 shows the approximate distribution of community based waste management activities, in relation to the whole city of Nairobi. It can be seen that most of the projects are located in low income high density areas.

Table G.1-2 Known Groups Involved in Community Based Waste Management Activities

Group	Type of Group	Location	Members	Main Activities	Sponsors	Facilitators
Afya Bora Group	Self help	Kawangware market	17	Composting Community health	Urban Slums project of NCC	FSDA, Urban slums project of the NCC
Mathare Youth Sports	Youth	Various slums	10,000	Sports Aids awareness Regular clean ups	Norwegian aid, private sector well-wishers	Mathare Youth Sports Association
Kinyago Youth Groups (2)	Youth	Pumwani	10	candles and soap from waste oils and fats	Funds from within Undugu Society	Undugu Society of Kenya
Help Self Help Centre Womens' Group	Self-help	Maili Saba		Waste paper briquettes candles from waste oils	Donations	Help Self Help (NGO)
City Park Environmental Group	Self help	City Park Hawkers Market	16	Composting	Asian Foundation/ FSDA	FSDA
Mathare Mbolea	Self help	Mathare	10	Composting	FSDA	FSDA
Huruma Cisa	Self help	Huruma	2	Composting	FSDA	FSDA
Lunga Lunga	Self help	Lunga Lunga	20	Composting, Urban Agriculture	FSDA	FSDA
Kinyago Bidii	Self help	Biafra/ Pumwani	25	Composting, Urban Agriculture	Undugu Society, FSDA	FSDA
Kayaba-Mwanganza	Self help	Industrial area	20	Composting	FSDA	FSDA
Kibera Siranga	Self help	Kibera	100	Composting, Clean Ups, Family Planning	FSDA	FSDA
Ushirika Womens' Group	Self help	Kibera	20	Urban Agriculture, Composting	FSDA	FSDA
Kuku Womens' Group	Self-help	Dandora	15	Composting, nursery school	Uvumbuzi Club	FSDA
Nyayo Market Mbolea Group	Self-help	Korogocho	15	Composting	Uvumbuzi Club	FSDA
Mukuru Project	Self help	Dandora Dumpsite	40	Urban Agriculture, Recycling inorganic Wastes	Kariobangi Catholic Church, HABITAT	(New Project/Group)

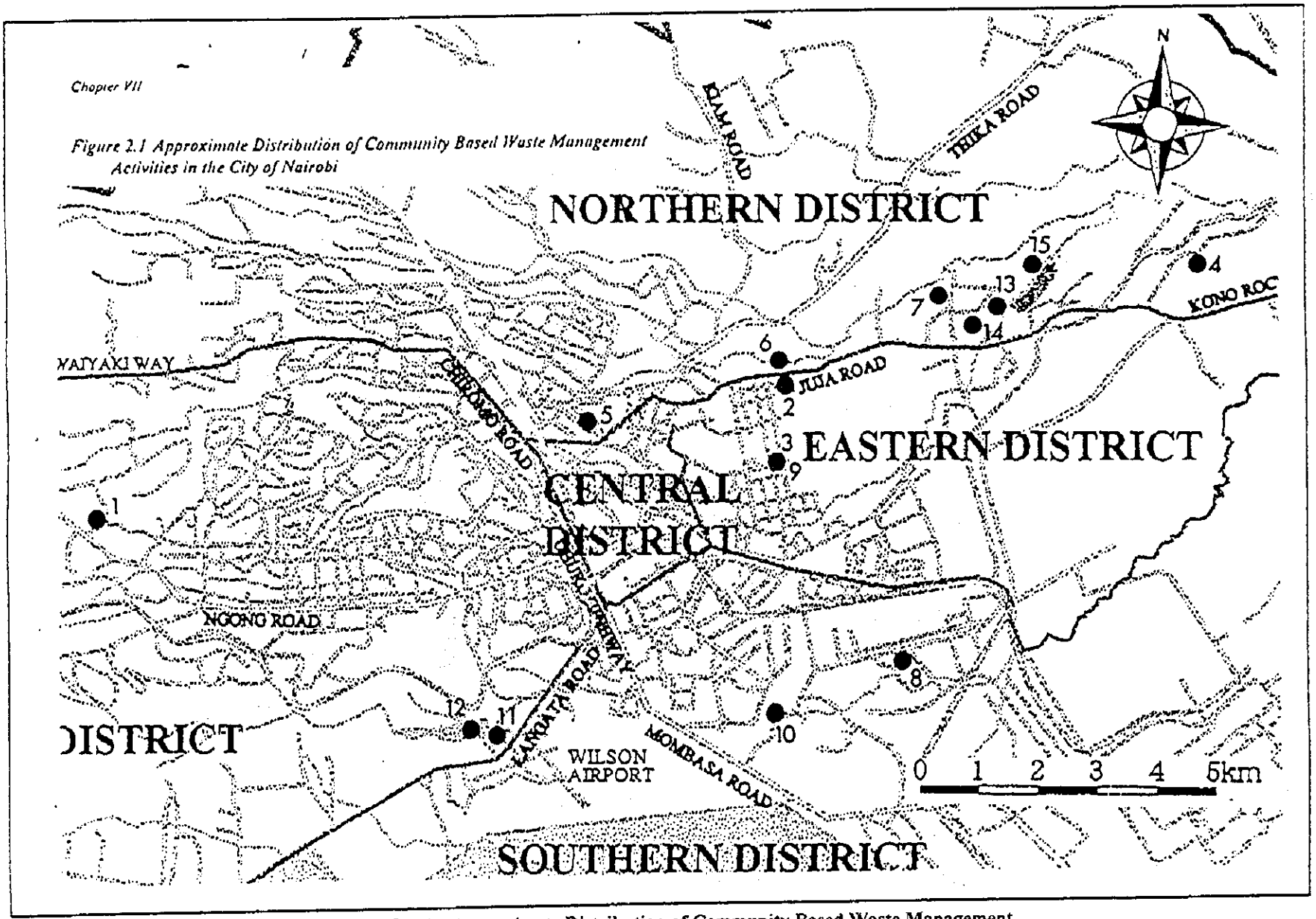


Figure G.1-1 Approximate Distribution of Community Based Waste Management Activities in the City of Nairobi

(2) Impact of Community Based Waste Management Activity in the City of Nairobi

Rough estimates are presented below for the average monthly production of compost by the groups mentioned in **Table G.1-3.**

Table G.1-3 Estimated Average Monthly Production of Compost by Known Groups Involved in Community Based Solid Waste Management Projects

Group	Source of waste for compost production	Estimated production of compost (kg/month)	Estimated compost sales (Kshs/month)
Afya Bora Group	Kawangware Market	600	3,000
Mathare Youth Sports	n/a	n/a (clean ups)	n/a
Kinyago Youth Groups (2)	Waste oils from city hotels/restaurants	n/a (make soap and candles)	n/a
Help Self Help Centre	Waste paper and charcoal dust from households/waste oils from city hotels	n/a (make briquettes and candles)	n/a
City Park Environmental Group	City Park Hawkers' Market	2,500	12,500
Mathare Mbolea	Households	1,000	5,000
Huruma Cisa	Households	1,000	5,000
Lunga Lunga	Households	500	2,500
Kinyago Bidii	Households	n/a (have had a land tenure problem)	
Kayaba-Mwanganza	Households	600	3,000
Kibera Siranga	Households	300	1,500
Ushirika Womens' Group	Households	200	1,000
Kuku Womens' Group	Households	1,000	5,000
Nyayo Market Mbolea Group	Nyayo Market	600	3,000
Mukuru Project	Dandora Dumpsite	n/a (recycle inorganic wastes)	
Estimated total amount of compost produced		8300 kgs/month	

Given that it takes approximately 3 kgs of organic waste (fruit and vegetable peelings, etc) to produce 1 kg of compost, a very rough estimate of the

amounts of waste currently being handled through composting by organised self-help groups is 25 tons per month (8,300kgs compost produced x 3kgs of waste required to produce 1kg of compost = 24,900 kgs of waste used/month). The total amount of waste generated in the City of Nairobi per month is estimated to be between 24,800 and 37,200 tonnes, of which 70% is organic and 60% is domestic waste. Taken in the overall context, the impact on the city's refuse handling is almost negligible. However, in the local context, on sites where composting does take place successfully, the localised impacts have included better public health and cleanliness of the area, and in some cases a supplement to an already low income.

Markets for the compost include small farmers, landscapers and tree/plant nurseries, and households which have gardens. Compost prices have in general been fixed at Kshs 5 per kilogram.

(4) The Nairobi Compost Coordinating Group

The Nairobi Compost Coordinating Group was formed in October 1996 following a two day seminar which was held to plan the future direction for the composting groups once donors pull out of them. The aim was to give full autonomy to group members to be able to manage their affairs (see below) themselves.

The Group has been registered as a Self-Help Group with the Department of Social Services, Ministry of Culture and Social Services. Membership currently consists of the following groups: Afya Bora Group, Kuku Womens' Group, City Park Environmental Group, Kibera Siranga, Lunga Lunga, Kayaba-Mwanganza, Huruma Cisa, Mathare Mbolea, Bidii-Pumwani, Ushirika Womens' Group, and the Mukuru Project.

Major decisions to be made by the Group include:

(a) Training and "refresher" courses on compost production and quality;

(b) Quality control: regular laboratory testing of the compost;

(c) Certification of the compost quality;

(d) Uniform pricing and packaging;

(e) A trade name for the compost; and

(f) Setting up a trial garden for testing the compost and its suitability for particular crops.

Constraints facing the Group in implementing the above include: a lack of finances to effect the decisions, and no central facility/land space for the storage and packaging of the compost. Two decisions which have been made by the Group are a standard price of Kshs 5 per kilogram for the compost, and the sharing out of orders for compost once the rainy season begins.

1.3 Documentation of Case Studies

1.3.1 Why the Case Studies were Chosen

(1) Kawangware Afya Bora

- Successful project in a slum area
- Small scale donor support
- Solved the problem of the market dumpsite - at least 50% of wastes from the market are handled by the composting group

(2) City Park Hawkers Market

- Successful project in high income residential area
- Relied on major donor support - excellent infrastructure for the project
- Helped lower problem of waste scavenging in the market
- Has reduced problem of market dump site - NCC need to collect much less frequently

(3) Kitui Pumwani Integrated Project

- Composting project failed due to "land grabbing"
- Have experimental projects on candles, soap, and waste paper briquettes
- Sensitised community: source separation is carried out by 100% of all households

(4) Karen and Langata District Association

- A pioneering resident's association lobbying for services and accountability by NCC and Central Government. Some successful court cases have resulted in similar groups being formed throughout the city, mainly in high income areas.

Two of the case studies (Kawangware Afya Bora, and the Kitui Pumwani Integrated Project) highlight clearly a land tenure problem which threatens the future and sustainability of such projects. All three of the composting groups have had a high turnover of members and group sizes have shrunk, indicating a lack of immediate returns for labour inputs.

1.3.2 The Kawangware Afya Bora Project

Kawangware market is a self-help market with about a thousand stalls, situated in the Kawangware informal settlement, in the western part of Nairobi. Kawangware market is patronised by Kawangware residents. Market days are held twice a week. Estimated waste generation per week is 2 tonnes.

(1) Background and Project Setup

(a) Formation of the group, and how it got involved in waste management activities

The Kawangware Afya Bora Group was set up in 1993 as a voluntary community based health project, under the auspices of the Nairobi Urban Slums Development Project of the Nairobi City Council. Activities included regular clean ups held within Kawangware. Tools were provided by the Urban Slums Development Project.

In 1995 the NGO Foundation for Sustainable Development in Africa (FSDA) was commissioned by the United Nations Centre for Human Settlements (HABITAT) to implement a project on "Demonstrations of Small Scale Composting for Treatment of the Organic Waste Fraction of Municipal Waste". FSDA identified a large dump site adjacent to Kawangware Market which seemed to be an appropriate place for setting up a demonstration site. FSDA then began looking for an existing community group in the area which would be willing to participate in the project.

The Kawangware Afya Bora Group was identified through contact with the local administration in the area (the Chief), and the Chairman of the Market. A workshop was organised by FSDA, and held in September 1995 during which the idea of composting the organic fraction of waste was introduced, and the group was also taken to see a working demonstration of composting at the City Park Hawkers' Market.

The Afya Bora Group agreed to extend its activities to include composting, and the project was implemented within 10 months of the workshop (July 1996). Compost production started in September 1996. FSDA provided technical support to the Group.

(b) Project set up and implementation

(i) The registration process

The Afya Bora Composting Group has been acknowledged and supported by the local administration (Chief, District Officer, Social Development Officer) in the area. However, it has not as yet been registered in its own right, although this is planned for the immediate future. Currently it operates under the umbrella of the Afya Bora Community Health Group.

Registration will be with the Department of Social Services, Ministry of Culture and Social Services, as a self-help group.

(ii) Group structure

There is no formal structure as yet, although elections for appointing office bearers have been scheduled. It has been agreed that the office bearers (Chairman, Secretary, Treasurer, Committee Members) shall be women. There is currently a group leader, and there is a representative from the group who attends the meetings of the Nairobi Compost Co-ordinating Group.

(iii) Negotiating for land

The land where Afya Bora carries out its composting activities used to be a noxious dumping site with waste piled as high as the market wall. The land has actually been demarcated as a road reserve. The dump site was used by market stall holders, and residents around the area. It was not uncommon to find dead bodies of animals and on occasion human babies in the dump. Once the group agreed to try and start a composting project, it took 10 months for them to negotiate and organise clearance (requiring trucks and bulldozers) of the dump by the Nairobi City Council. The initial understanding was that the group would then be able to use all the land previously occupied by the dumpsite for waste management activities. However, once the area was clear, the market extended its space for stalls by 100m, and a smaller space was set aside for the composting activities.

No *formal* agreement has been made about the land. There is a verbal agreement with the local administration which gave permission for group activity on the site. The DO has issued a warning that if the group becomes lax and a dumpsite grows again, the group will be evicted. As the land itself is actually a road reserve and hence public, the site itself is temporary and its future is insecure.

(iv) Liaison with NCC and the local administration

The Afya Bora Community Health Project was started under the auspices of the Urban Slums Development Project of the NCC. At first the community were reluctant to have contact with NCC representatives. Once the project was up and running, liaison with the NCC has occurred, but only when there has been a specific requirement - NCC organised the initial clearance of the dump site, and earlier in 1994 the construction of 2 garbage cubicles by the main road, from which dumped wastes could be collected by NCC vehicles (although this happens rarely). Liaison with the local administration has taken place mainly for registration of the Group and storage of ready compost and tools (in the Chief's offices).

(v) Setup requirements: infrastructure and tools/equipment

Tools were provided by the urban slums project during the initiation of the clean up activities of the Afya Bora Health project (late 1995, early 1996) - and these same tools are being utilised for the composting project. The shade and the initial fencing for the site were donated by FSDA. Technical assistance and training were carried out by FSDA, and included the supply of composting booklets and posters about waste management to the group, and field trips to two different composting projects (City Park and Kuku Womens' Group).

(2) Project Running

(a) Current group membership and socioeconomic aspects

Current membership of the composting group is 17 people. Ages range from 22 to 60, and the highest level of education attained is Form 4. All members live in Kawangware. Reasons for work vary from "hobby" and "providing a role model for younger generations" to getting some supplementary income. All members run "petty" businesses as their main source of income.

(b) Current group activities

The group only deals with composting. Scavengers come and collect other items (such as inorganic wastes for recycling) from the market. Demand for the compost is greater than the group can currently produce. Members work 1 day a week.

(c) Systems and modalities

Waste is transported by handcarts. Ready compost and tools are stored in the Chief's office. Markets are mainly to people (householders and small farmers) who know about the project and are well wishers.

(d) Future plans

All group members are hopeful for the composting project to develop into a business to supplement income. The space is currently too small to expand into any other waste management activities.

(3) Project Analysis/Evaluation

(a) Compost production and sales

A schematic diagram of the Afya Bora site used for producing compost is shown in **Figure G.1-2.**

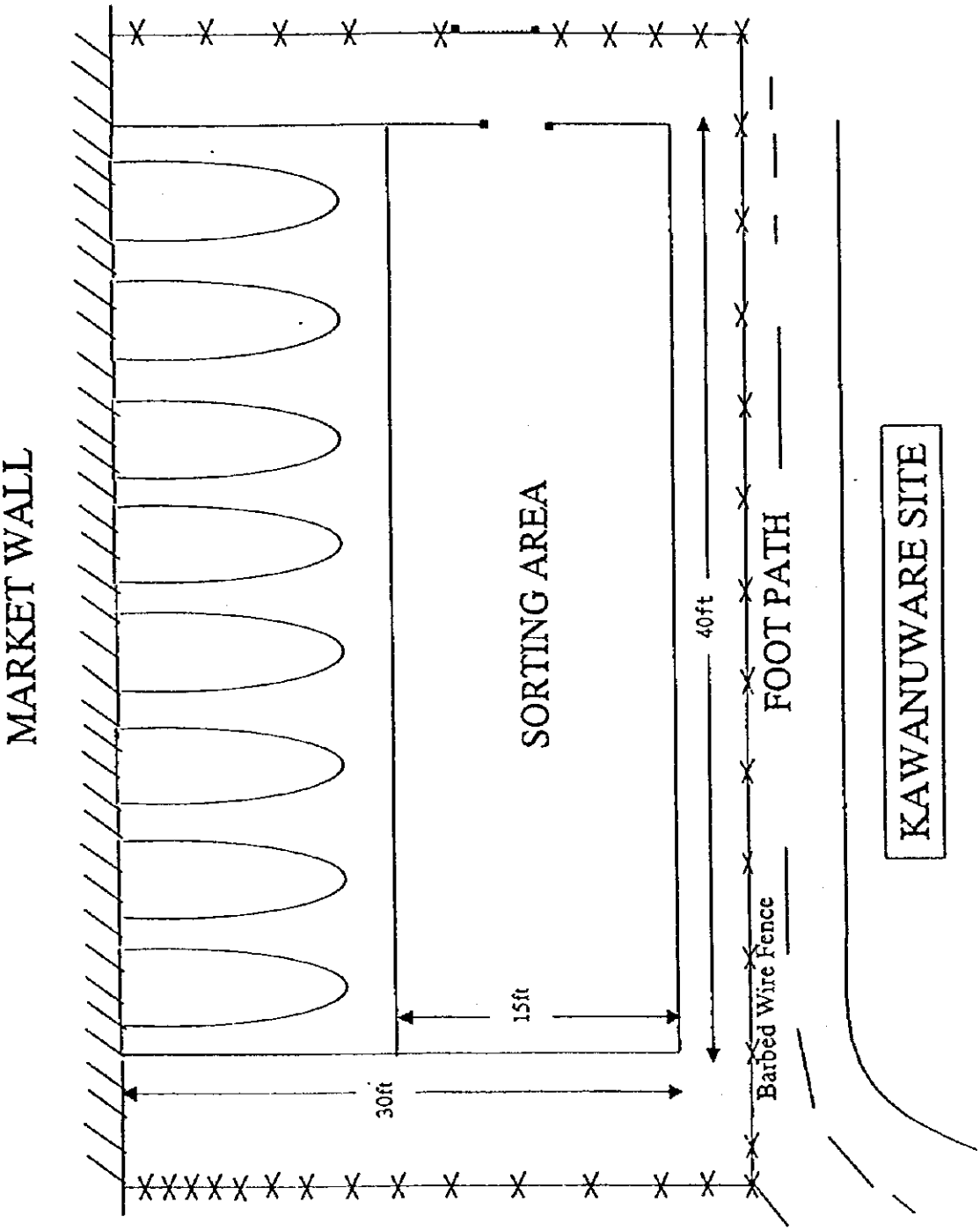


Figure G.1-2 Layout of the Afya Bora Site for Compost Production

Potential production estimate

Assuming that, in general, a compost pile of the size 5 ft by 10 ft, with a thickness of 5 ft produces approximately 1 ton of compost [see **Section 7.3, Data Book (1)**], the Afya Bora site has the potential of producing, after an 8 week start-up period, 1 ton of compost a week.

This estimate assumes that all inputs to the composting process are readily available, and that there are no constraints to production. If it is assumed that compost production during the very dry months (January - March) falls to 50% of that during the other months, then the total potential annual compost production for the Kawangware Afya Bora site is approximately 46 tons.

Table G.1-4 Actual Production of Compost vs. Estimated Potential Production, Kawangware Afya Bora

Year	Month	Potential compost production (tons)	Actual compost production (kg), and % of potential	Notes
1996	July	1		Start up period
	August	1		Start up period
	September	1	360 (36%)	Learning period
	October	1	250 (25%)	Learning period
	November	1	0	Drought
	December	1	0	Drought
1997	January	0.5	0	Drought
	February	0.5	0	Drought
	March	0.5	1,260 (126%)	Produced from wastes collected in dry season
	April	1	Still under process	

Table G.1-5 Compost Sales, Kawangware Afya Bora

Year	Month	Compost sales (Kshs)
1996	July	
	August	
	September	1,800
	October	1,250
	November	0
	December	0
1997	January	0
	February	0
	March	6,300
	April	Still under process
Total Sales to Date:		9,350

All compost produced to date has been sold (at a price of Kshs 5/kg), and the group is holding some pending orders (approx. 5 tonnes).

Kshs 3,000 from the income accrued has been spent by the group in reinforcing the fence for the composting site. All other income has been shared among the members. With future sales, the group plans to open a bank account and use the accrued money to buy project land.

(b) Estimated start-up costs

Start up costs are estimated to have been approximately Kshs 100,000 for the following:

- Shade and fence
- Gumboots, gloves
- Weighing scale
- Sieve
- Tools
- Packaging bags
- Training

The shade, fence, and training were donated by FSDA, while all tools were provided by the Urban Slums Project of the NCC.

(c) Group response to the project

Members of the Group were not sceptical about the project initially, as they had been to the workshop organised by FSDA, and had also visited the existing project at Dandora, and City Park. Poor attendance by some group members has been a constraint to production of the compost. Almost all members perceive that the project can be income generating for them, and voluntarily put in hard work (when they can) for the time being.

(d) Outside community perceptions

The market community was pleased about the project: they were able to extend their space, and the nuisance of the dumpsite was no longer a problem. Neighbouring residents had reservations about the project. Some residents protested to NCC, the Member of Parliament for the area, and the local administration, perceiving the project as a way of "grabbing" the road reserve. FSDA was warned to either withdraw the project or face legal action. Eventually, however, better awareness was spread about the project by NCC, FSDA, local administration, and the group itself. Recently the neighbouring residents have even thanked the group for creating a cleaner environment.

(e) Impact on waste flow

The group uses approximately 50% of the wastes produced by the market to produce compost. The rest of the wastes are taken by a private land owner to fertilise his land. The dumpsite no longer exists.

(f) Constraints

- Water availability, especially during the dry season
- Labour turnout - sometimes poor, as group members are busy trying to earn incomes through their own petty businesses
- Infrastructural requirements
- Security (e.g., storage of tools), and vandalism
- Land tenure
- Green wastes during the dry season (sold to zero grazing farmers during dry season for their livestock)
- Poor drainage during the wet season

1.3.3 The City Park Environmental Group

(1) Background and Project Setup

City Park Hawkers Market with 1,006 stalls is situated within the Parklands area. It is patronised by middle to high income residents living within its surroundings. The market operates every day of the week. Estimated waste generation is 3 tons per day.

(a) Formation of the group, and how it got involved with waste management activities

While the Nairobi City Council was entitled legally to collect and maintain waste flow within the market, the waste generation rate of about 3 tons a day was too high for the NCC to cope. A large uncontrolled dumpsite resulted, which caused concern to customers of the market (health grounds), and brought in scavengers (causing insecurity) to the market. Occasionally noxious medical wastes were found disposed of on the dumping site. Contact was made with two representatives of the Asian Foundation, in order to seek a solution to the problem.

The Group was formed in October 1994 to control waste generated by the market, and set up a model to demonstrate how communities could come together and improve their environment, as well as prove that wastes are a neglected resource.

(b) Project set up and implementation

(i) The registration process

The Group has been registered at the Department of Social Services, Ministry of Culture and Social Services, as a self-help project.

(ii) Group structure

The project is headed by a lady Chairman, secretary, treasurer, and committee members.

(iii) Negotiating for land

The land on which the project stands belongs to NCC, and it was set aside for waste dumping. The influence of the Asian Foundation (the donors for the market construction) helped the community to be given the site for composting activities but only after promising NCC that they would be able to control effectively waste that the market generates. All these negotiations were however not officially documented, since the project was viewed as an experiment.

(iv) Liaison with NCC and the local administration

While the market community has not been in good books with the NCC (a case is pending in court over payment of rates to NCC) the project has enjoyed reasonable understanding, as NCC has always honoured the group's requests whenever they needed collection of excess wastes in the market. Liaison mainly has been with the local administration (Social Services Office). This has been in terms of group registration procedures, logistical systems and advice on day-to-day project running, e.g., withdrawal and recruitment of members to the project.

(v) Setup requirements: infrastructure and tools/equipment

FSDA was approached by the Asian Foundation in September 1994, and arrangements were made to train the group in composting technology. The group was trained and the project officially started in October 1994 with a membership of 25.

Initial set up costs were met by different donors, the prime one being the Asian Foundation for structures, tools and fencing. FSDA donated the initial temporary structure, and training.

(2) Project Running

(a) Current group membership and socioeconomic aspects

The group is currently made up of 16 members living in different estates but having a common interest in the market, as they are all stall owners. Out of the total membership 2 people have never been to school, while the remaining reached a level ranging from standard 3 to form 4. All members earn their livelihoods from businesses they operate in the market, hence, their priority is to safeguard their businesses from any detrimental factors (e.g., waste dumping and scavenging).

(b) Current activities

The group only deals with composting. Scavengers may come and collect other items, although they do so less frequently than before. Demand for the compost is greater than the group can currently produce.

The group also started up an informal class for the street girls who were previously scavengers at the dumpsite. Management of the class has, however, been handed over to the Asian Foundation.

(c) Systems and modalities

For three (half) days a week the group members engage themselves in sorting waste from source (the market stalls) and on-site. The organic fraction of the waste is put on windrow compost piles whilst at the same time the piles made the previous week are turned. Any ready compost is sieved, weighed, packaged, and stored (on site) ready for sale. Both wastes and ready compost are transported using wheelbarrows.

(d) Future plans

The group plans to expand the project site so that they may be able to use all the wastes that the market generates and to be able to supply a larger range of market with the compost produced.

With future sales, the group plans to open a bank account and use the accrued money to expand and maintain the project and take full responsibility of running the street girls' informal class.

They also plan to connect power lines and to be able to use a chaff cutter to cut wastes such as banana leaves and branches into smaller sizes to quicken decomposition and to easen their job, especially during turning.

(3) Project Analysis/Evaluation

(a) Compost production and sales

A schematic diagram of the City Park site used for producing compost is shown in **Figure G.1-3.**

<u>Potential production estimate</u>

Assuming that, in general, a compost pile of the size 5ft by 10ft, with a thickness of 5ft produces approximately 1 ton of compost [see **Section 7.3, Data Book (1)**], the City Park site has the potential of producing, after an 8 week start-up period, 3 tons of compost a week.

This estimate assumes that all inputs to the composting process are readily available, and that there are no constraints to production. If it is assumed that compost production during the very dry months (January to March) falls to 50% of that during the other months, then the total

potential annual compost production for the City Park site is approximately 138 tons.

Table G.1-6 Actual Production of Compost vs. Estimated Potential Production, City Park Environmental Group

Year	Month	Potential compost production (tons)	Actual compost production (kg), and % of potential	Notes
1996	September	3	4,000 (133%)	
	October	3	1,000 (33%)	Members dropping out
	November	3	1,000 (33%)	Members dropping out
	December	3	2,000 (67%)	Members dropping out
1997	January	1.5	2,800 (187%)	Drought
	February	1.5	400 (27%)	Drought
	March	1.5	800 (53%)	Drought
	April	3	600 (40%)	Drought
	May	3	300 (20%)	Still under production

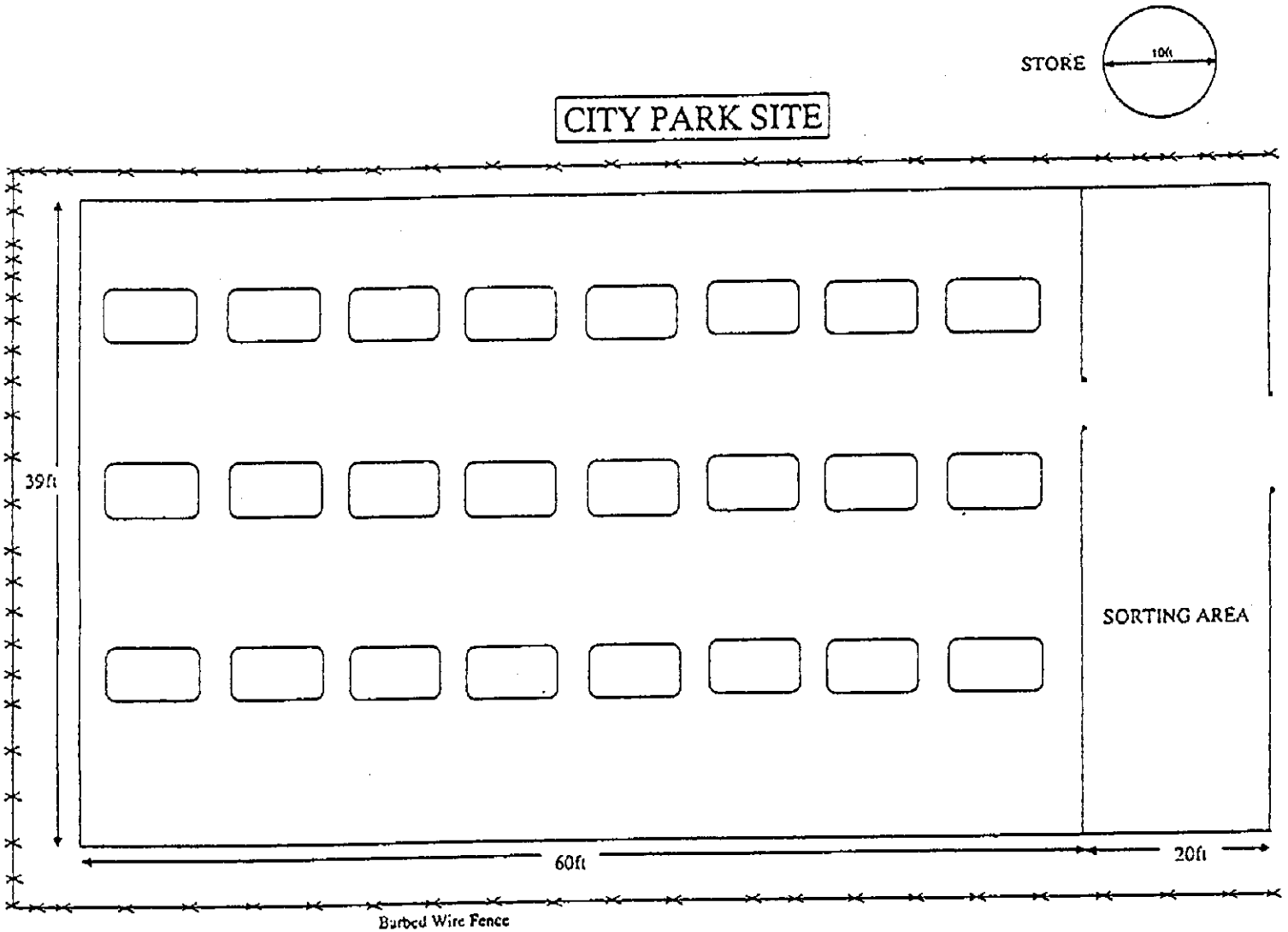


Figure G.1-3 Layout of the City Park Site Used for Compost Production

Table G.1-7 Compost Sales, City Park Environmental Group

Year	Month	Compost sales (Kshs)
1996	September	20,000
	October	5,000
	November	5,000
	December	10,000
1997	January	11,200 (sold at 4/- per kg)
	February	2,000
	March	4,000
	April	3,000
	May	unsold
Total Sales to Date		60,200

All compost produced to date has been sold (at a price of Kshs 5/kg and packed in 20kg bags), and the group is holding some pending orders (approx. 5 tons).

Currently the project produces a large quantity of compost that is readily sold out to farmers, florists, and landscapers from Nairobi and surrounding areas. Sales and production however fluctuates with weather conditions and seasons of the year.

Money accrued from compost sales is spent on project maintenance and any surplus shared amongst members after an agreed period of time.

(b) Estimated start-up costs

Start up costs are estimated to have cost approximately Kshs 700,000 for the following:

- Compost shades and fencing
- Gumboots, gloves, scarves
- Weighing scale
- Sieve
- Tools
- Packaging bags
- Wheelbarrows
- Compost and tool store
- Chaff cutter
- Training

All items were donated by the Asian Foundation, while training and an initial temporary shade was given by FSDA.

(b) Group response to the project

Having started the project with a total number of 25 persons, the number reduced to 10 within the first six months and thereafter to 5 in the next 11/2 years. FSDA and the Social Service Office was forced to call a crisis meeting in early 1997 in order to solve the problem. More

members were recruited, and the current group size lies at 16 people. The group also operates with a new approach (money accrued from compost sales must be deposited in a bank account, every member must pay a registration fee as a sign of commitment, fines for lateness or absenteeism for work), which has proven effective.

(c) Outside community perceptions

Within the first 3 weeks, the group was faced with stiff opposition from the other fellow hawkers with reasons that:

(i) The windrow system of compost piling was perceived to be a threat to market cleanliness.

(ii) Anything to do with waste sorting was associated with street boys (scavengers, homeless people) so the market would be turned into a centre for scavenging.

(iii) The Asian Foundation volunteers were using the group to set up a recycling project in the market for their own future benefits (e.g., monetary benefit utilising free labour).

It took an awareness campaign organised by the group and addressed by FSDA, NCC representatives, and even a puppet show to diffuse the tension.

(d) Impact on waste flow

The project has managed to minimise waste spread and reduced the frequency of collection by NCC to once a month (compared to a previous requirement of once a week). The project consumes about 70% of the total waste generated by the market.

This project has given birth to an informal school which is currently managed by the 2 Asian volunteers and funded by the project and other well wishers to rehabilitate street girls that were initially scavenging on the dump site. This is a clear sign of the progress that such a kind of project can bring in a society.

(e) Constraints

- Space for composting is too small to absorb all the wastes produced by the market
- Water
- Green wastes during dry seasons
- Labour turn out
- Store too small

1.3.4 The Kitui Pumwani Integrated Project

(I) Background and Project Setup

(a) Formation of the group, and how it got involved in waste management activities

The Kinyago-Bidii self help group was an already existing group for community development under the sponsorship of the Undugu Society of Kenya [see **Section 7.5, Data Book (1)**]. Activities included setting up of small businesses, low cost housing, and urban agriculture.

The idea of composting was suggested to the group by FSDA through the Undugu Society. Recycling on a small scale already occurred through one of the enterprises promoted by the Undugu Society: weaving of mats using banana fibre, sisal and polythene from polythene bags.

(b) Project setup and implementation

(i) The registration process

The group was an existing group, under the umbrella of the Kinyago-Bidii self help group

(ii) Group structure

The project is headed by a chairman, secretary, treasurer, and committee members.

(iii) Negotiating for land

An appropriate site (land used for dumping) was initially identified by the group. The local administration (Area Chief) was approached and temporary ownership was awarded to the Group. The agreement was informal and verbally done.

(iv) Liaison with NCC and the local administration

Strong links with local administration, especially the Office of Social Services, and Area Chief's Office already existed. No liaison has occurred with the NCC.

(v) Setup requirements: infrastructure and tools/equipment

Tools and structures were provided by FSDA. The Undugu Society assisted with group co-ordination, and providing training venues.

The group were trained in waste management techniques (source separation of wastes and composting) by FSDA in 1994.

(2) Project Running

(a) Current group membership and socioeconomic aspects

Currently the composting group consists of 25 members. All members are low income earners, dependent upon petty businesses for survival. Ages vary from 25-70 years. Education ranges from no formal education to Form 4.

(b) Current group activities

Group activities include renting out houses, weaving mats, composting and the production of soap and candles from waste oils and fats collected from hotels and restaurants in the city. Composting activities were halted for a period because the land used was "grabbed" by a private developer. The site has now been given back to the group, and composting has started once again. The group is experimenting with the production of briquettes from waste paper and charcoal dust, as a source of fuel and alternative to wood fuel.

(c) Systems

All households are well sensitised and practice source separation. Individuals carry the wastes up to the composting site. The households generate few plastics, papers and other inorganic wastes. These are used for weaving, picked up by scavengers or dumped on a dumpsite across the road from the village.

(d) Future plans

Composting activities have started in earnest once again. The group plans to re-build structures for a shade and put fencing around the composting site, build a store, and put water piping up to the composting site.

(3) Project Analysis/Evaluation

(a) Compost production and sales

The group has pending orders of approximately 2 tons. Production has been nil pending resolution of the land tenure issue.

(b) Group response to the project

There was initial scepticism by the group members. There was some minimal income generated by the compost sales before problems over land tenure started, this coupled with high demand for compost has developed confidence in the group members.

(c) Outside community perceptions

The village where the project is being carried out is unique in that the whole village is united under one village elder. Every project that is started in the village is endorsed by the village committee during their monthly meetings. Thereafter the whole village is mobilised to implement the project.

(d) Impact on waste flow

Every household in the village has been able to adopt source separation systems hence no waste is thrown randomly in the village. Waste dumping occurs across the road from the village, the source of the waste is mainly from Biafra, a neighbouring housing estate.

(e) Constraints

The main constraint to the project has been land: the land originally demarcated for the project was "grabbed" by a private developer (through the same local administration who had given the informal verbal agreement). Structures that had been put up were pulled down by the private developer. Pressure by the community and the Undugu society on the local administration has now resulted in the site being given back to the project. However, the site is still under an informal agreement, and therefore insecure.

Other constraints include:

- Water availability
- Transport equipment for transporting waste from the village to the site, and for transporting the ready compost
- Secure storage for the compost and tools
- Marketing (although there are pending orders, it is mainly during the rainy season)
- Insecurity and vandalism

1.3.5 The Karen Langata District Association

(1) Background to the Association

The Karen Langata District Association was originally formed in the 1950s, starting as an Association that catered for residents of the Ngong area, and then in 1966-7 extending to the residents of both Karen and Langata.

Initial membership of the Association was characterised by "settlers", but now it has a wider membership of which about 35% is indigenous.

After the independence of Kenya, the Association was seen as potentially high profile, and therefore possibly threatening. It became moribund, with one

chairman for 30 years, and relying on getting things done through use of "the old boy network" to pull strings. The year 1994 characterised a period of change for Kenya heralding the era of multi-party politics. There continued to be a deterioration in services from the Nairobi City Council and Central Government. There was change in the Association itself, whose activities were now to focus on "demanding rather than asking" and lobbying for improved services and accountability in the public organs that provide those services.

(2) Objectives and Activities of the Association and in Particular Pertaining to Waste Management

The main objectives of the Karen Langata Residents Association "are to promote and protect the general interests of the Members of the Association in accordance with the Association's motto "The Future - Our Responsibility".

Current membership is 679 people, mainly residents of the Karen Langata area, and because of heightened public interest in the Association, two new categories of membership have been introduced: Corporate and Associate. Funding of the Association is through membership subscription, and through donations by well wishers. Membership is from high income earners.

Current activities of the Association are focused upon lobbying and litigation on issues that are of grave concern to the residents of the Karen Langata area, and which also happen to be issues of national interest, such as "land grabbing", increases in rates, etc. There is no liaison with the Association - the position they take is that for the past 25 years they have tried to liaise with City Hall and local administration without much effect.

The Association states a number of problems that currently face the residents of the area in terms of solid waste management. Among them are:

(a) The City Council in general do not collect waste from the area, and even if they do, the service is unreliable at best.

(b) Dumping occurs, but where possible the Association tries to identify the parties involved in order to try and rectify the situation.

(c) Current mentality of the wider community is to blame others rather than to attempt to take positive action oneself.

The Association has not as yet attempted to achieve community participation in managing waste, saying that in order to do so a certain level of basic infrastructure and services needs to exist.

(3) Analysis/Evaluation of Activities

There has been much scepticism by the community at large in the past about the Association, but this was attributed to a culture of fear - with worries about what might happen to one's physical, business, livelihood' safety. Community interest was therefore difficult to raise. A number of landmark decisions were made in successful court cases brought by the Association, in particular the

suspension of the imposition of a standing maintenance charge by Kenya Posts and Telecoms. A case in court against the NCC is still pending, and until the outcome of the court case, residents of the area do not have to pay service charges to the NCC. The underlying themes in the NCC case are (i) that if no services are being provided the public should not have to pay for them, and (ii) that the charges are being imposed illegally, since the proper budgetary and accountability procedures were not being followed.

Since the success of the two court cases, and the generated public interest in the activities of the Association, membership of the Association has increased and has been expanded to incorporate corporate and associate members. There has also been a marked increase in the number of people paying the service charges to the Association rather than the NCC. The Association is holding this money in a Trust Account.

Another measure of the impact the Karen Langata District Association has had lies in the formation of similar Associations throughout the city in areas such as Loresho, Lake View, Lavington, Gigiri, and the Central Business District. The Karen Langata Association plans to set up an umbrella body to provide guidance and support for other similar Associations to develop and take up issues of a public interest (the concept of an ombudsman).

The Association also considers itself in a position to be considered as a pilot borough if plans to decentralise Nairobi are implemented.

1.4 Recommendations

1.4.1 Summary of Main Points from Project Evaluations

All the three composting projects reviewed had very similar problems which constrain them from achieving their potential compost production rate.

- Land is a central issue: without a formal agreement on the space for the composting activities, the site will always be insecure.
- Lack of secure storage space means that seasonality of demand cannot be hedged against: in the dry season there is a low demand for compost, and groups do not produce because there is no place to store the compost, and access to water and green wastes is more difficult (they compete with farmers for the green wastes, as farmers buy to feed their livestock). At the start of the rains, compost demand suddenly escalates, and groups cannot produce enough to meet the demand. Revenues from compost sales are therefore not as high as they could be.
- The nature of composting means that a certain lead time is required before any financial gains may be realised. Most people are on very low incomes and start on a composting project with expectations of more immediate returns. Because this is not forthcoming, morale falls and there is a high drop out rate in the group.

- Poor infrastructure affects compost production: compost piles need a certain degree of protection from the elements to prevent over drying or washing away. Composting sites are frequently subject to vandalism.
- Outside communities tend to have misconceptions about the initiatives and may go so far as to try and block the projects.

1.4.2 General Problems and Constraints Faced by Community Groups

Consultations with the groups under the umbrellas of FSDA, MYSA, Uvumbuzi Club, and the Undugu Society (see **Table G.1-2**) in general revealed the following problems and constraints faced by some of the groups in starting up and implementing community based waste management projects:

(1) Location and Site

- Lack of transportation means for garbage collection and transport of ready compost to potential markets
- Sites frequently inaccessible due to poor access roads
- Sites in areas which deter potential buyers who would not be willing to come for fear of insecurity/walking/driving in the slum
- Lack of space for a site to start activities, or lack of permanent site
- Political issues: threat of "land grabbing"
- Lack of a central collection point easily accessible by road
- Insecurity: storage of tools, vandalism

(2) Incentive

- Labour intensive nature of the work has deterred some members
- Lack of strong and dynamic leadership in the group
- Low motivation by members not seeing any immediate financial gains

(3) Community Attitudes

- Community interference: children play on the site, goats, sheep, and chickens may roam the sites and eat some of the wastes
- Changing the public attitude e.g. community to stop using the land as waste land as dumping site/public toilet facility
- Residents of the area in one of the projects started to ask for money for the wastes
- Vandalism

(4) Markets

- Supply cannot meet demand in the rainy season, in the dry season supply may be greater than demand, and the groups have no place to store the compost

- Lack of vigorous marketing strategies
- Lack of ready market for some of the more inaccessible sites
- Synthetic fertilisers are widely available in the shops, whereas awareness about compost is low

(5) Others

- Green wastes essential for composting are sold to cattle farmers, especially in the dry seasons

1.4.3 Reasons for Success or Failure of the Projects Chosen as Case Studies

(1) Kawangware Afya Bora

- All members were already community health volunteers, and willing to put effort into the project
- All members perceive the project to be income generating in the long-term
- Support given to the project by the local administration, and the Urban Slums Project of the NCC
- High demand for the compost
- Site is accessible by road

(2) City Park Environmental Group

- Located within a busy market patronized by people of middle to high income
- Good security and infrastructure
- Accessible by road
- Start-up and additional infrastructural costs met by donors
- Members have a common interest to keep the market clean to safeguard business interests
- Land for the project was easily acquired, and although subject to an informal agreement, is relatively secure
- Waste separation is carried out at source, and wastes are readily available throughout the year
- Effective awareness campaign carried out after initial opposition by the market community
- The project now enjoys the support of the market committee, NCC, Government, and the surrounding communities
- High demand for the compost
- Close supervision and constant technical advice by FSDA and the SDO
- New system to ensure regular attendance by members has been developed and implemented

(3) Kitui Pumwani Integrated Project

- Project failed due to a land tenure issue

(4) Karen Langata District Association

- Members are high income earners, and are therefore able to contribute financial resources
- Successful court cases have raised the profile of the Association, and increased public confidence in it

1.4.4 Recommendations

(1) Policy Issues

A policy for solid waste management at community level should be iterated by the Government, and it should encompass:

- waste disposal systems at household level - in order to control/prevent random dumping alternatives need to be provided, e.g., better services; planning for waste management to be incorporated for new developments; systems for waste management to be developed for informal settlements, e.g., garbage cubicles (but to ensure success, waste needs to be collected on regular basis); encouragement and incentives to minimise wastes at household level.
- incentives to encourage compost production to be developed including establishing distribution channels, awareness about compost, and controls on levies for chemical fertilisers
- start up incentives (e.g., tools and equipment, infrastructural requirements such as shades/structures/storage) for groups wishing to start up composting projects
- clear policy about land tenure

(2) Composting Cooperative/Central Marketing Board

- Composting to be run as business - in order to ensure labour is compensated for and production rates maintained (ensures labour, income generation), aggressive marketing of compost
- Central agency for composting could provide centralised spaces for storage and purchase of compost; co-operative transportation; lending; purchase of tools and equipment

(3) Planning and Land

- Areas set aside for composting/waste management activities to be included during planning stages for any new estates/markets, etc.
- Areas in existing estates, markets, informal settlements to be identified
- Tracts of land should be large enough: suggested minimum areas and estimated start up costs are shown in **Figure G.1-4** and **Table G.1-8**

- Land set aside/identified as suitable for composting/waste management activity should be leased to interested group at favourable rates e.g. as an incentive, rent free for first 6 months, until income has been accrued from compost sales.

(4) Public Awareness

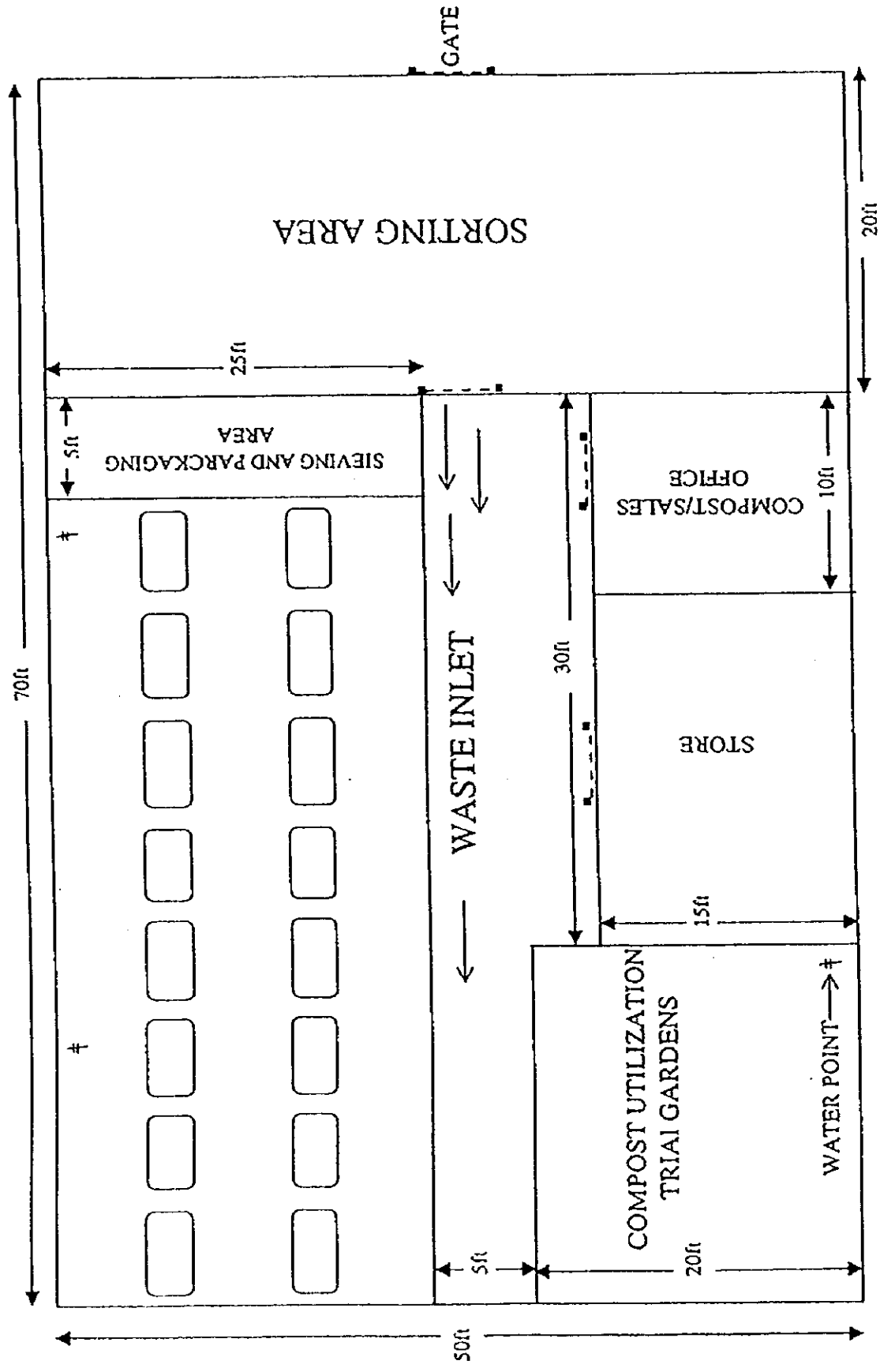
- Policy and rules governing waste disposal systems need to explained to all residents of the city, enforcement made more efficient
- NCC liaison workshops with residents of area to address public awareness and NCC community relationship, and to develop communication links
- Awareness needs to be spread to farmers and landscape gardeners about the advantages of compost use

(5) Compost Certification and Testing

- Systems put in place for compost testing, and certification, in conjunction with the Kenya Bureau of Standards, the Kenya Agricultural Research Institute, and the Universities
- Develop standards for compost blending and quality
- Field trials need to be put in place for testing the suitability of compost for certain crops
- Research to find suitable evergreen plants (such as napier grass, comfrey) which can supplement green wastes during the dry seasons

(6) The Nairobi City Council

- Streamline communication levels, and achieve general awareness about whom to liaise with
- Develop and provide a co-ordinating role for groups involved in waste management activities
- Form a response team to develop and implement solid waste management systems for existing informal settlements, and informal settlements which "spring up"
- Form a liaison committee to make contact with and address issues raised by District/Residents and Community organisations



Suitable for 15members working twice a week(half day)
estimated weekly production = 2tons income -kshs.10,000 per week

Figure G.1-4 Conceptual Layout of a Model Compost Site

Table G.1-8 Estimated Startup Requirements and Costs for a Composting Project

Item	Details	Estimated Cost (Kshs)
Training	Field trips,materials, resource people	10,000
Tools	Forkspades,jembes,hose pipe,watering cans, weighing scales,pangans sieves	40,000
Shade	Iron sheets wooden Frames,nails	150,000
Lockable Store/Office	Stone wall,iron sheets, strong door,shelves	120,000
Water points		Depends upon source of water
Seeds	For packaging compost	4,000
Initial compost quality testing		12,000
Fencing	Posts,chain link,barbed wire,mails etc.	30,000
Labour		10,000

1.4.5 Model for Community Based Solid Waste Management Initiatives in Nairobi City

Step 1 Identifying the Problem

Facilitator of the project must identify the informal settlement where the project is to be carried out.

The identification of the problem must not be imposed on the community. See public awareness, below.

Step 2 Liaising with Local Administration and the NCC

Communication must be made with the Chief who will identify village elders and the community, and will liaise with both the higher levels of authority (Local Administration) and the community itself.

It is not known how to liaise with NCC, which is only approached when some service is needed (e.g., clearing a dumpsite). It is suggested that contact is made with the

Director of the Environment in order to establish a NCC liaison committee, so that the project proceeds with the knowledge and support of the NCC.

Step 3 Public Awareness: Gaining the Understanding and Support of the Wider Community

Public awareness about wastes and the problems/dangers to community health needs to be spread. Ideas need to be solicited from the community on how it can be solved. Methods to include Chief's Barazas, field tours arranged for village elders and local administration.

Step 4 Finding a Group

Identify an existing group (if possible) through Village Elders, Area Chief and Social Development Officer.

Step 5 Gaining the Understanding and Support of the Group Members

Organise field trips to existing projects, highlight also problems that might occur, and requirement for non-reliance on donors.

First hand information to be given by the group members (of the existing project) themselves, which is a way of giving inspiration/motivation to the potential group.

Step 6 Securing Land

Group members themselves should identify the land that may be used for composting, which if possible should not be public utility land (no security of land tenure). It should be near main sources of waste, accessible by handcart for example.

Formal agreements (documented) about the land need to be made with the District Officer.

Step 7 Formalising the Group

A constitution to be defined by the group themselves (with advice by the Social Development Officer) in order to define the objectives of the group. The group must then apply for formal registration through the Social Development Officer to the Director of Social Services, Ministry of Culture and Social Services. The group can operate for a while after application, but until registration is approved, it cannot open a bank account.

Step 8 Training the Group and Setting Up the Project

A set up period of approximately 14 months is suggested during which all the above steps will have been completed. 7 months is allocated for communicating with the group and initial training/field visits, formalising the group, securing land, and putting up infrastructure. 4 months is allocated for initiating compost production, training the group to manage the process, test compost quality, and expose the group to ways of marketing the compost. A period of 3 months is set aside for handing over the project to full control by the group, with visits by the facilitators being phased out. During this period the group will also be trained on keeping records, evaluating performance, and other techniques useful for small businesses/income generating projects.

Step 9 Running the Project Successfully (Production, Marketing, General Management)

Regular training workshops to be held including "refresher" courses on compost production, management, marketing, and evaluating financial performance.

2. REPORT ON PILOT STUDY FOR COMPOSTING GROUPS

2.1 General

This report outlines work completed in accordance with the Terms of Reference for the Pilot Study for Composting Group on The Study on Solid Waste Management in Nairobi City in the Republic of Kenya.

2.2. Improvement and Expansion of the Existing Facilities

2.2.1 Renovation and Expansion of the Existing Shade

Renovation and expansion of the existing shade including purchase of poles, roofing sheets, cement, sand, gravel and labor for the area approximately 15 x 3 meters has been completed as shown in **Photograph 1.**

Photograph 1. Renovated shade

2.2.2 Improvements to Operation

Improvements to operations including purchase of three (3) hosepipes, installation of guttering and rainwater collection system for the plant has been handed over to the Kuku Women's Group on 13 January, 1998.

Guttering and rainwater collection system has been installed, including an overflow system for directing excess flow away from the composting yard. Trenches have been dug in order to divert leachates and excess water away from the compost piles.

Photograph 2. Rainwater collection

2.2.3 Purchase of Tools for Composting Works

The tools for composting work including one (1) weighing scale, one (1) heavy duty sieve, fifteen (15) gumboots, fifteen (15) gloves and fifteen (15) scarves have been purchased and handed over to the group on 13th January, 1998.

2.3 Capacity Building, Training, and Marketing

2.3.1 Preparation of Standard Composting Manuals

Preparation of standard composting manuals including writing and printing of fifty (50) sets of the manuals has been completed. Copy of the manual is appended in **Section 7.6, Data Book (1)**. Copies will be handed over to NCC, Kuku Women's Group, groups represented at the workshop held to establish links between the composting groups and the NCC, and the Nairobi Compost Coordinating Group.

2.3.2 Certification of Compost Quality

Certification of compost quality (quarterly testing) for testing of four (4) samples has completed with the results tabulated in the following.

Table G.2-1 Test Results of Compost Quality

Parameter	Test Results			
	Sample 1	Sample 2	Sample 3	Sample 4
pH (in H_2O)	9.30	8.77	7.80	9.3
Carbon (%)	2.41	6.23	1.87	2.22
Nitrogen (%)	1.06	6.23	0.95	1.04
Phosphorous (ppm)	410.00	21.55	200.00	500
Potassium (mg/100g soil)	60.00	49.2	24.50	55
Calcium (mg/100g soil)	5.50	1.95	10.00	7
Magnesium (mg/100g soil)	5.40	2.25	6.70	4.6
Sodium (mg/100g soil)	7.50	6.60	5.00	7
Copper (ppm)	1.00	0.63	0.25	1
Iron (ppm)	5.00	21.10	15.00	5
Zinc (ppm)	11.00	1300.00	170.00	6
Manganese (ppm)	366.00	1110.00	110.00	390

2.3.3 Establishment of Packaging and Labeling Systems

Establishment of packaging and labeling systems including development of labeling, i.e., appropriate use of compost, instructions for use with different crops, composition, etc., purchase of two hundred (200) packaging bags, and printing of two hundred (200) labels.

Packaging system (packaging bags with labels printed on the bags) is shown in **Photograph 3.** Instructions for use for the compost are appended in **Section 7.6, Data Book (1).**

Photograph 3. Packaging the compost

2.3.4 Capacity Building Program

Capacity building program for two (2) days including training on record/book keeping, marketing, product advisory services, training of trainers, and development of simple on-site quality testing techniques.

Training on improved composting techniques, product advisory, marketing, record keeping, and training of trainers has been done. Material from the manual was used and tested extensively in the training, and modified accordingly. The manual thus contains a record of the content of the training sessions.

A good liaison has been established with the soil science laboratory of the department of Agriculture and Veterinary Sciences, University of Nairobi, for the quality testing of compost, and development of simple on-site quality testing techniques.

Photograph 4. Better compost production

2.3.5 Promotion of Public Awareness

Promotion of public awareness including production of two hundred and fifty (250) brochures, and two hundred and fifty (250) posters for marketing products to suppliers farmers and households.

Posters have been printed and distributed.

Text for the brochures is appended in **Section 7.6, Data Book (1).** Five hundred (500) copies have been printed and distributed to the composting groups and the Nairobi Compost Coordinating Group.

2.4 Establishing Links between NCC and the Groups

2.4.1 Facilitating One Day Workshop

Facilitating 1 day workshop with the objective of establishing a liaison committee, and to create NCC's role e.g. supply of green wastes during dry seasons to enable consistent production of compost, product popularization, assistance with transportation.

Workshop took place on 22 December, 1997 with approximately 50 participants. Workshop report is shown in **Chapter 3**.

3. REPORT FOR THE WORKSHOP ON STRENGTHENING LINKS BETWEEN NCC AND COMMUNITY BASED COMPOSTING GROUPS CONDUCTED IN CONNECTION WITH THE PILOT STUDY FOR COMPOSTING GROUP

3.1 Introduction

3.1.1 General

There are currently 15 community groups involved in composting and other waste management activities, mainly concentrated in low income areas in Nairobi. Composting at the community level has the potential to effectively augment an overall solid waste management master plan for the City of Nairobi, and at the same time be income generating for the community groups involved. There are, however, a number of constraints facing the community groups. These are iterated fully in previous **Chapter 1** and summarised below in **Section 3.2** of this report.

The concept of the JICA Pilot Project on Composting is to effectively address some of the constraints that the communities face, and to develop a standardised and improved system for the composting process (to achieve higher and better quality yields of compost), that may be replicated.

The project consists of three main activities:

(1) Improvement and expansion of existing facilities for a selected composting group

(2) Capacity building, training and marketing

(3) Establishing links between the NCC and the groups

3.1.2 Workshop Objective

The general objective of the workshop was to try and establish a mechanism between the Nairobi City Council and the Community Groups involved in composting in order to:

- set up a community link with the NCC; and
- strengthen joint co-operation between NCC and the communities in managing wastes at a local level.

3.1.3 Workshop programme and list of participants

The workshop programme and list of participants are presented in Tables G.3-1 and G.3-2.

3.2 Summary of Constraints Facing Community Groups Involved in Composting

3.2.1 Summary of Main Points from (Composting Case Study) Project Evaluations

All the composting projects reviewed had very similar problems which constrain them from achieving their potential compost production rate, as follows:

- Land is a central issue: without a formal agreement on the space for the composting activities, the site will always be insecure.
- Lack of secure storage space means that seasonality of demand cannot be hedged against: in the dry season there is a low demand for compost, and groups do not produce because there is no place to store the compost, and access to water and green wastes is more difficult (they compete with farmers for the green wastes, as farmers buy to feed their livestock). At the start of the rains, compost demand suddenly escalates, and groups cannot produce enough to meet the demand. Revenues from compost sales are therefore not as high as they could be.
- The nature of composting means that a certain lead time is required before any financial gains may be realised. Most people are on very low incomes and start on a composting project with expectations of more immediate returns. Because this is not forthcoming, morale falls and there is a high drop out rate in the group.
- Poor infrastructure affects compost production: compost piles need a certain degree of protection from the elements of weather variation to prevent over drying or washing away. Composting sites are frequently subject to vandalism.
- Outside communities tend to have misconceptions about the initiatives and may go so far as to try and block the projects.

3.2.2 General Problems and Constraints Faced by Community Groups

Consultations with the groups under the umbrellas of FSDA, MYSA, Uvumbuzi Club, and the Undugu Society in general revealed the following problems and constraints faced by some of the groups in starting up and implementing community based waste management projects:

(1) Location and Site

(a) Lack of transportation means for garbage collection and transport of ready compost to potential markets

(b) Sites frequently inaccessible due to poor access roads

(c) Sites in areas which deter potential buyers who would not be willing to come for fear of insecurity/walking/driving in the slum

(d) Lack of space for a site to start activities, or lack of permanent site

(e) Political issues: threat of "land grabbing"

(f) Lack of a central collection point easily accessible by road

(g) Insecurity: storage of tools, vandalism

(2) Incentive

(a) Labour intensive nature of the work has deterred some members

(b) Lack of strong and dynamic leadership in the group

(c) Low motivation by members not seeing any immediate financial gains

(3) Community Attitudes

(a) Community interference: children play on the site, goats, sheep, and chickens may roam the sites and eat some of the wastes

(b) Changing the public attitude e.g. community to stop using the land as waste land as dumping site/public toilet facility

(c) Residents of the area in one of the projects started to ask for money for the wastes

(d) Vandalism

(4) Markets

(a) Supply cannot meet demand in the rainy season, in the dry season supply may be greater than demand, and the groups have no place to store the compost

(b) Lack of vigorous marketing strategies

(c) Lack of ready market for some of the more inaccessible sites

(d) Synthetic fertilisers are widely available in the shops, whereas awareness about compost is low

(5) Other

(a) Green wastes essential for composting are sold to cattle farmers, especially in the dry seasons

3.3 Recommendations from the Workshop

The main recommendation from the workshop was for ***the formation of a joint liaison committee between the NCC and the Composting Community.***

3.3.1 Background

The composting community has managed to organise a composting co-ordinating body, with a membership comprising of all currently known composting community groups in Nairobi. This has been an important first step for the community groups, however, the co-ordinating group has not been effective since formation because of a lack of resources and of strategic direction.

The NCC's problems in the past have been (a) not knowing about the groups and (b) not knowing which group to approach, or which group is representative of the composting community.

The NCC knows and appreciates that there are CBOs which have taken the step of realising that in solid waste management there is also a role and responsibility by the community, and the public at large. There is also a role for NCC in the activities of the community groups, for example to provide support and advice to the community groups in addressing some of their practical operational problems.

3.3.2 Scope of the Joint Liaison Committee

The joint liaison committee is intended to be the forum for the NCC to meet with the community groups, and to start the process of finding solutions to some of the constraints faced by the community groups.

While some of the groups took the opportunity at the meeting to express individual problems that they were facing, all the groups agreed that the purpose of the joint committee would be to address issues relevant to all the groups. It was also emphasised at the meeting that NCC has limitations in what it can realistically do, and therefore expectations should not be raised within the communities. The NCC's strongest role will be in its capacity to provide support and advisory to the community groups. What NCC cannot do, they can provide guidance on proper channels for dealing with the problems.

The following issues were identified at the workshop as issues for the Joint Committee to address (in order of priority):

(1) A central, accessible place for storage of compost produced by the groups, and for housing the Nairobi Compost Co-ordinating Group in order to strengthen marketing efforts. (Note, the idea has been mooted by NCCG, but they did not know who/how to contact at NCC)

(2) Request to NCC for a room in which the committee could meet on a regular basis

(3) NCC to arrange permission for groups to collect green wastes from NCC markets for their compost production during the dry seasons, to enable consistent production of compost.

(4) Groups that are situated near parks could be given permission to collect grass and leaves from the parks for their compost production.

(5) The Joint Committee should look into ways to educate others on composting - such as radio, newsletter, TV, and the joint organisation of public seminars and barazas at community level.

(6) NCC makes compost at Kariobangi for flowers and parks maintenance. The Joint Committee can discuss the possibility in the future of NCC buying compost from the groups to supplement the compost that they are producing.

3.3.3 Representation on the Joint Committee

The Community Groups agreed on their representation in the joint committee, which will include the leader (or leader's nominated representative) of each Community Group under the umbrella of the Nairobi Compost Co-ordinating Self Help Group.

The NCC is requested to nominate representatives to the joint committee.

3.3.4 Proposed First Meeting of the Joint Liaison Committee

It was proposed that the first committee meeting be held on 13th January at 9.30 am at the council chamber.

The agenda for the meeting was to address the issues stated in **Subsection 3.2.1** (in particular the first three priority items), and to set the modalities for meeting regularly.

3.3.5 The Proposed NCC Community Development Section

It was stated that the Department of the Environment have plans to start a Community Development Section (CDS) which will co-ordinate resource recovery. It is envisaged that the Joint Liaison Committee should be included as an arm of the proposed Community Development Section. In any case, the Joint Liaison Committee will hopefully provide the NCC with valuable "on the ground" experience in dealing with Community Groups involved in waste management.

Table G.3-1 Workshop Programme

Date: Monday 22 December 1997

Venue: Charter Hall, City Hall, Nairobi

Programme:

8.30 am Registration

9.00 am Opening

9.30 am Introductions of participants

9.45 am Presentations

(1) By representative of community group

(2) By representative of NCC

10.30 am Tea

11.00 am Discussion (General discussion on issues and raising suggestions)

12.30 pm Lunch

2.00 pm Video

2.30 pm Discussion (Focusing upon modalities of liaison)

3.30 pm Tea

4.00 pm Sum up/Conclusions, and charting the way forward

4.30 pm Closing remarks

4.45 pm End

Table G.3-2 Workshop Participants List

Surname	First Name	Title	Organisation	Address
Aboli	Michael	Mr	FSDA	22415
Atsiaya	Willimina	Ms	Wekhonye Group	
Etenyi	Moses	Mr	Mukuru Project	56349
Githua	John	Mr	NCC	53809
Kabuchi	Zipporah W.	Ms	Kuku Womens' Group	64540
Kamau	Moses	Mr	NCC	30108
Kibe	Mathew	Mr	WAC - Dandora	58078
Kingori	James	Mr	City Park Environmental Group	
Maeda	M.	Mr	JICA Study Team	
Maina	Zipporah W.	Mrs	NCC	52094
Makau	Joseph	Mr	City Park Environmental Group	
Mbatha	Valentine	Ms		
Mukita	Margaret	Ms	City Park Environmental Group	
Mulumba	Faith	Ms	SPEK	60125
Mumbi		Ms	Kuku Womens' Group	64540
Murioki	Muchina	Mr	Huruma Cisa	77325
Mwangi	Reuben	Mr	Huruma Cisa	77325
Namisya	Roselyne	Ms	Kayaba Mwangaza Group	30325
Nditi	Teresa	Ms	Lunga Lunga Group	78168
Nduku	Philomena	Ms	Lunga Lunga Group	78168
Njeri	Josephine	Ms	Kawangware Afya Bora	19475
Osundwa	Kenneth	Mr	Mathre Mental Hospital	35544
Ouma	Harrison	Mr	FSDA	
Salome		Ms	Kawangware Afya Bora	19475
Saini	Anjali	Ms	FSDA	
Takasugi	M.	Mr	JICA Study Team	
Wairimo	Mary	Ms	Mukuru Project	56349
Wambui	Esther	Ms	Mathare Mbolea	
Wangare	Grace	Ms	Pumwani Kinyago Bidii Group	17178
Wangechi	Ann	Ms	Mukuru Project	56349
Wangu	Sarah	Ms	Mukuru Project	56349
Wanjiku	H.	Ms	Kuku Womens' Group	64540

4. WASTE REDUCTION, RECYCLING AND INTERMEDIATE TREATMENT PLAN

4.1 General

This chapter deals with planning for solid waste reduction, recycling and intermediate treatment.

Formulation and implementation of the Master Plan up to the year 2008 is comprehensible as the first step to establish an integrated solid waste management system for Nairobi in the future.

In order to establish the integrated solid waste management system, it is required essentially to encompass the waste reduction, recycling and intermediate treatment systems together with the waste collection, transportation and disposal systems to increase efficiency and effectiveness.

Reduction of solid waste amount and recycling at generation sources can reduce the waste amount for collection, transportation and disposal services and lighten the cost burden to NCC. Moreover, it will be a useful measure to save finite resources. Meanwhile, benefit of intermediate treatment is stabilisation of residuals in addition to reduction of residual amount and recovery of resources by conversion of solid waste through incineration, composting and other processes.

Development of recycling and intermediate treatment plan under this section shall be conducted based on the planning objectives, policies and strategies decided earlier in **Volume 2, Chapter 3, Main Report - Master Plan Study** as a basic rule to realise a consistency for overall solid waste management planning. Further, considering the current financial difficulties of NCC, formulation of the recycling and intermediate treatment plan for the initial set up or the transition period shall have the required minimum system bring in the maximum level results proposed in the following subsections.

4.2 Solid Waste Amount and Composition

Sources and types of wastes generally appearing in municipal wastes are shown in **Table G.4-1.** NCC is responsible for collection and disposal of every waste listed in this Table, including domestic waste, institutional wastes, business and industrial wastes of less than 50 kg per generator and wastes from street sweeping. All of them shall be the objective wastes for reduction at each generation source.

Table G.4-1 Sources and Types of Municipal Solid Waste

Categories	Generation Sources	Types of Solid Wastes
Domestic Wastes	Single House Row House, Apartment Building	(General Waste : Organic Wastes) Food Wastes, Paper and cardboard, Plastic Bottles, Plastic Films & Others Textiles, Leather, Grass & Tree Trimmings Wood, Rubber, Other consumable goods
		(General Waste : Inorganic Wastes) Returnable Glass Bottles, Non-returnable Glass Bottles Other Glass & Ceramics, Ferrous Metals (Tin & Cans), Non-Ferrous Metals (Aluminium & Copper), Stone, Ashes, Dirt & Others
		(Bulky Wastes) Electric Apparatus, Furniture, Others
		(Domestic Hazardous Waste) Batteries, Fluorescent Lamps, Waste Paint, Waste Oil ,Waste Chemicals (Insecticides, Herbicides), Others
Institutional Wastes	Government Offices, Schools, Churches, Military Camps, Hospitals, Others	Same as above in Domestic Wastes, Non-Infectious Wastes from Hospitals
Business and Industrial Wastes	Stores, Markets, Restaurants, Office Buildings, Hotels, Factories	(Less than 50 kg per generator) Same as above in Domestic Wastes, Packagings & Packings, Cardboard
Street Sweepings	Streets, Parks	Grass & Leaves, Paper, Plastic Bottles & Films, Tin & Cans, Dead Animals, Stone, Ashes, Dirt & Others

The future solid waste quantity and quality in Nairobi City are estimated based on the result of two surveys conducted in April/November, 1997 as shown in

Table G.4-2. Future solid waste composition is estimated in consideration of the balance between organic and inorganic wastes in many developed countries commingled with municipal waste by the ratio between 10 and 20% for the inorganic wastes.

Table G.4-2 Estimated Municipal Solid Waste Amount and Composition

Composition		1997		2008	
		Amount (t/d)	Ratio (%)	Amount (t/d)	Ratio (%)
Food Waste		734	51.5	1,293	47.4
Paper	Recyclable	206	14.5	363	13.3
	Other Paper	41	2.8	71	2.6
Textile		38	2.7	67	2.5
Plastic	Container	67	4.7	118	4.3
	Other Plastics	102	7.1	179	6.6
Grass/Wood		96	6.7	168	6.2
Leather		13	0.9	23	0.8
Rubber		21	1.5	37	1.3
Organic Waste Subtotal		1,317	92.4	2,321	85.0
Glass	Container	21	1.5	81	3.0
	Others	11	0.8	43	1.6
Metal	Container	25	1.7	93	3.4
	Others	13	0.9	49	1.8
Others		38	2.7	143	5.2
Inorganic Waste Subtotal		109	7.6	410	15.0
Total		1,426	100.0	2,730	100.0

4.3 Summary of Investigation of the Community Based Solid Waste Management Activities in Nairobi

Following is a summary of investigation of the community based solid waste management activities in Nairobi and the details are reported in **Chapter 1.**

4.3.1 General

Currently there are 15 groups involved in composting and other waste management activities, mainly concentrated in low income areas. Composting by the groups have a potential of income generation, however, they are facing with a numbers of constraints to maintain the activities. The most important of these is procurement of land on which to carry out the activities.

Three case studies of community projects in composting indicate that two of them are successful to an extent and the third group denotes clearly how land tenure can constrain such a project.

The Karen Langata District Association is a pioneering lobby group with a membership of residents (mainly high income) of the Karen Langata area. Activities of the Association include lobbying and litigation on issues that are of concern to its members. A number of landmark court decisions in favour of the Association and a case being brought against the NCC, (residents of the area do not have to pay service charges pending the outcome of the court case) has led to a rapid increase in

membership of the Association, and the emergence of similar groups throughout the City.

Recommendations are focused on a view to consolidating ways in which community based solid waste management can augment an overall SWM Master Plan for Nairobi City. These recommendations include: (a) development of policy governing waste management at community level; (b) planning for space to be set aside for waste management activities; (c) a central agency to market compost; and, d) establishment of NCC liaison groups and regular communication with community groups and residents' associations.

4.3.2 Known Groups involved in Community Based Waste Management Activities

Currently, there are 15 community groups involved in the formation and production of compost as shown in **Tables G.4-3** and **G.4-4**.

As shown in **Table G.4-3**, 11 groups out of 15 known groups are supported by the Foundation of Sustainable Development in Africa (FSDA) and 10 groups produce solid waste derived compost. Total number of member reached at approximately 10,300 people.

Table G.4-4 indicates the estimated amount of final products of compost of each group ranging from 200 to 2,500 kg per month. Total production amount reaches 8,300 kg per month which is equivalent to raw material input of 20 to 30 tons per month or 0.7 to 1 ton per day. In other words, the community groups collect and treat municipal solid waste of about 1 ton everyday. The compost is sold at 5 Kshs per kg and the groups earn 41,500 Kshs per month.

Table G.4-3 Known Groups Involved in Community Based Waste Management Activities

Group	Type of Group	Location	Members	Main Activities	Sponsors	Facilitators
Afya Bora Group	Self help	Kawangware market	17	Composting Community health	Urban Slums project of NCC	FSDA, Urban slums project of the NCC
Mathare Youth Sports	Youth	Various slums	10,000	Sports Aids awareness Regular clean ups	Norwegian aid, private sector well-wishers	Mathare Youth Sports Association
Kinyago Youth Groups (2)	Youth	Pumwani	10	candles and soap from waste oils and fats	Funds from within Undugu Society	Undugu Society of Kenya
Help Self Help Centre Women's Group	Self-help	Maili Saba		Waste paper briquettes candles from waste oils	Donations	Help Self Help (NGO)
City Park Environmental Group	Self help	City Park Hawkers Market	16	Composting	Asian Foundation/FSDA	FSDA
Mathare Mbolea	Self help	Mathare	10	Composting	FSDA	FSDA
Huruma Cisa	Self help	Huruma	2	Composting	FSDA	FSDA
Lunga Lunga	Self help	Lunga Lunga	20	Composting, Urban Agriculture	FSDA	FSDA
Kinyago Bidii	Self help	Biafra/ Pumwani	25	Composting, Urban Agriculture	Undugu Society, FSDA	FSDA
Kayaba-Mwanganza	Self help	Industrial area	20	Composting	FSDA	FSDA
Kibera Siranga	Self help	Kibera	100	Composting, Clean Ups, Family Planning	FSDA	FSDA
Ushirika Women's Group	Self help	Kibera	20	Urban Agriculture, Composting	FSDA	FSDA
Kuku Women's Group	Self-help	Dandora	15	Composting, nursery school	Uvumbuzi Club	FSDA
Nyayo Market Mbolea Group	Self-help	Korogocho	15	Composting	Uvumbuzi Club	FSDA
Mukuru Project	Self help	Dandora Dumpsite	40	Urban Agriculture, Recycling inorganic Wastes	Kariobangi Catholic Church, HABITAT	(New Project/ Group)

Table G.4-4 Estimated Average Production of Compost by Known Community Based Groups

Group	Source of waste for compost production	Estimated production of compost (kg/month)	Estimated compost sales (Kshs/month)
Afya Bora Group	Kawangware Market	600	3,000
Mathare Youth Sports	n/a	n/a (clean ups)	n/a
Kinyago Youth Groups	Waste oils from city hotels/restaurants	n/a (make soap and candles)	n/a
Help Self Help Centre	Waste paper and charcoal dust from households/waste oils from city hotels	n/a (make briquettes and candles)	n/a
City Park Environmental Group	City Park Hawkers' Market	2,500	12,500
Mathare Mbolea	Households	1,000	5,000
Huruma Cisa	Households	1,000	5,000
Lunga Lunga	Households	500	2,500
Kinyago Bidii	Households	n/a (have had a land tenure problem)	
Kayaba-Mwanganza	Households	600	3,000
Kibera Siranga	Households	300	1,500
Ushirika Women's Group	Households	200	1,000
Kuku Women's Group	Households	1,000	5,000
Nyayo Market Mbolea Group	Nyayo Market	600	3,000
Mukuru Project	Dandora Dumpsite	n/a (recycle inorganic wastes)	
Estimated total amount of compost produced		8300 kgs/month	

4.3.3 General Problems and Constraints Faced by the Community Groups

Consultations with the groups under FSDA, MYSA, Uvumbuzi Club, and the Undugu Society in general revealed the following problems and constraints faced by some of the groups in starting up and implementing community based solid waste management projects.

(1) Location and Site

(a) Lack of transportation means for garbage collection and transport of ready compost to potential markets

(b) Sites frequently inaccessible due to poor access roads

(c) Sites in areas which deter potential buyers who would not be willing to come for fear of insecurity/walking/driving in the slum

(d) Lack of space for a site to start activities, or lack of permanent site

(e) Political issues: threat of "land grabbing"

(f) Lack of a central collection point easily accessible by road

(g) Insecurity: storage of tools, vandalism

(2) Incentive

(a) Labour intensive nature of the work has deterred some members

(b) Lack of strong and dynamic leadership in the group

(c) Low motivation by members not seeing any immediate financial gains

(3) Community Attitudes

(a) Community interference: children play on the site, goats, sheep, and chickens may roam the sites and eat some of the wastes

(b) Changing the public attitude e.g. community to stop using the land as waste land as dumping site/public toilet facility

(c) Residents of the area in one of the projects started to ask for money for the wastes

(d) Vandalism

(4) Markets

(a) Supply cannot meet demand in the rainy season, in the dry season supply may be greater than demand, and the groups have no place to store the compost

(b) Lack of vigorous marketing strategies

(c) Lack of ready market for some of the more inaccessible sites

(d) Synthetic fertilisers are widely available in the shops, whereas awareness about compost is low

(5) Others

(a) Green wastes essential for composting are sold to cattle farmers, especially in the dry seasons

4.3.4 Reasons for Success or Failure of the Projects Chosen as Case Studies

(1) Kawangware Afya Bora

(a) All members were already community health volunteers, and willing to put effort into the project

(b) All members perceive the project to be income generating in the long-term

(c) Support given to the project by the local administration, and the Urban Slums Project of the NCC

(d) High demand for the compost

(e) Site is accessible by road

(2) City Park Environmental Group

(a) Located within a busy market patronised by people of middle to high income

(b) Good security and infrastructure

(c) Accessible by road

(d) Start-up and additional infrastructure costs met by donors

(e) Members have a common interest to keep the market clean to safeguard business interests

(f) Land for the project was easily acquired, and although subject to an informal agreement, is relatively secure

(g) Waste separation is carried out at source, and wastes are readily available throughout the year

(h) Effective awareness campaign carried out after initial opposition by the market community

(i) The project now enjoys the support of the market committee, NCC, Government, and the surrounding communities

(j) High demand for the compost

(k) Close supervision and constant technical advice by FSDA and the SDO

(l) New system to ensure regular attendance by members has been developed and implemented

(3) Kitui Pumwani Integrated Project

(a) Project failed due to a land tenure issue

(4) Karen Langata District Association

(a) Members are high income earners, and are therefore able to contribute financial resources.

(b) Successful court cases have raised the profile of the Association, and increased public confidence in it.

4.4 Resource Recovery by Community Based Groups

4.4.1 Resource Recovery by the Scavengers

(1) General

Questionnaire survey was conducted for the scavengers in Dandora dumping site, who are recovering recyclable materials from the municipal solid waste. Some 513 people responded to the questionnaire.

In this section, the result is analysed and presented for the types and amount of recovered materials. The social aspects of the questionnaire survey to the scavengers were described separately in **Section K.**

(2) Types and Amount of Material Recovered by Scavengers

Table G.4-5 and **Figure G.4-1** show the result of questionnaire survey on 513 scavengers. There were duplication of data in recovery amount because of existence of middle men among the scavengers. Accordingly, the recovery amount data shall be explained as reference only.

Types of materials recovered by scavengers are more than 30 types and the major materials recovered are ferrous metal (tin & cans), plastics, bottles, bones, paper, textile, non ferrous metal (aluminium & copper), etc. In average, each scavenger recover 46 kg and earn 105 Kshs per day.

Table G.4-6 shows unit selling price of major recovery material obtained from the questionnaire survey for scavengers. Average selling price was calculated at 2.4 Kshs per kg. Unit price for each type of recovery material ranges from 1.8 to 3.5 Kshs per kg for ferrous metal and non ferrous metal respectively. Among the major recovery material, the cheapest selling price is offered at 1.8 Kshs per kg for ferrous metal and paper. Meanwhile, hearing survey for recycling company shows the purchasing price ranges 3 to 5 Kshs per kg. for plastics and ferrous metal. Judging from the difference of unit price between the questionnaire survey and that of the hearing survey from recycling companies, the recovery amount per scavenger is estimated about 30 kgs per day more or less.

Table G.4-5 Type of Recovery Material Collected by Scavengers

Ferrus Metal	Plastics	Bottle	Bone	Paper	Textile	Non-ferrus Metal	Spoon	Net	Fire Wood	Others	Total
21	12	83	73	7	54	50	1	1	6	47	744

Breakdown of Other Recovery Material

Bags	3	
Bott tops	3	Metal
Bulbs	1	
Carton Box	1	Paper
Fat	3	
Food	4	
Gloves	1	
Kenchic	1	
Na s.w	1	
Onion	2	
Paint	1	
Sacks	4	
Scraps	6	
Shining	1	
Shoes	1	
Skins	1	
Soles	1	
Sponge	1	
Tyres	1	
Waste Mat	5	
NoAnswwer	8	
Etc.	1	
Total	62	

Collected Amount and Income Per Day by 513 Scavengers

	Average	Total
Daily Min. Weight	46	21,86
Daily Max. Weight	65	30,957
Daily Min. Income (KSh)	10	52,832
Daily Max. Income (KSh)	14	70,684

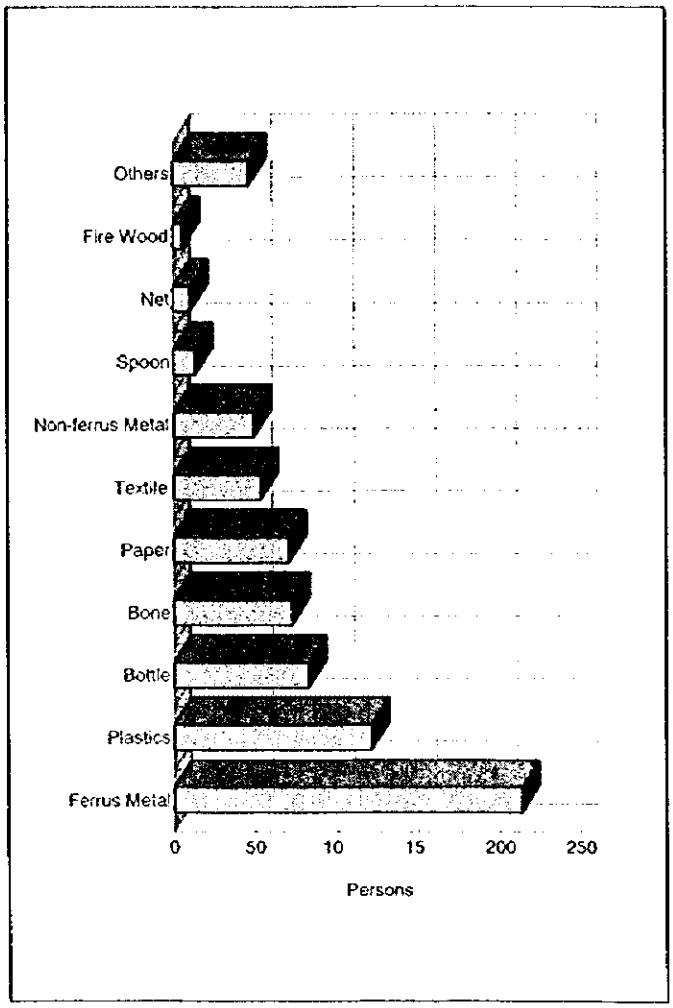


Figure G.4-1 Type of Recovery Material Collected by Scavengers

Table G.4-6 Recovered Material Price in Nairobi

Summary of Scavenger Survey						Unit Price of Recovered Material Obtained from Scavenger Survey		Unit Price of Recovered Material Obtained from Market Survey (Ksh/kg)
Type of Recovered Material	Number of Recovered Material Collected from 513 Scavengers	Average Value						
		Daily Min Collection Weight (kg)	Daily Max. Collection Weight (kg)	Daily Min. Income (Ksh)	Daily Max. Income (Ksh)	From Avg. Daily Min. Income (Ksh/kg)	From Avg. Daily Max. Income (Ksh/kg)	
Non-Ferrous Metal	63	41	55	143	192	3.5	3.5	
Plastics	192	40	59	85	125	2.1	2.1	
Paper	83	46	58	82	101	1.8	1.8	
Ferrous Metal	223	57	86	105	145	1.8	1.7	
Others	183	39	51	120	149	3.1	2.9	
Average	-	46	65	105	141	2.4	2.3	
Total	744	21,866	30,957	52,832	70,684	-	-	

4.4.2 Resource Recovery of Mukuru Projects

Data and information of the self-help, Mukuru Group, project has been collected. The group consist of the Project A and Project B and operated approximately 60 and 40 members respectively.

The data was obtained from the Project A for the sale amount and revenue from the recovered materials in 1996. The total sale amount of the recovered materials reached at 1,018 tons in the year and earned approximately 1.55 million Kshs.

In addition to the materials recovery, the Project A produce compost from green waste collected from the neighbouring households and markets. The records from July to November, 1997 shows the production amount 5,500 kgs, sale amount 1,650 kgs and earnings 8,750 Kshs in the period.

4.5 Role of NCC in Waste Reduction and Recycling

Solid waste is generated as a consequence of human activities and cause public nuisance unless integrated solid waste management system is operated in participation of all the parties concerned including the Government, local government, enterprises and residents. The role and responsibility of each party shall be clarified by the legislative measures to establish effective solid waste management for the municipality.

In this respect, NCC shall be responsible for public campaign and education, encouragement, assistance, coordination to form a link between the community groups and recycling companies.

Implementation of the programs by the community based groups such as women's groups, youth groups, schools, churches, markets, etc., will be the most effective and practical means. In order to organise the activities through the community based

groups, NCC is responsible to collect and publicise database on the community groups, list of recycling companies, trading sites of the recovered materials (buy-back centres), etc., and control/coordinate the standard price for maintaining a stable market for the recycling materials.

In order to practice resource recovery at disposal site, it would not be a wise way to ban materials recovery by the scavengers for the time being since NCC has been receiving a large benefit in volume reduction of solid waste at the disposal site by their activities without paying any cost, although NCC's control and/or systemisation is essential to give a position to scavengers in forming a better recycling system for NCC.

4.6 Waste Reduction and Recycling Plan

From the side of administrator, the program for waste reduction, recycling and recovery of resources at generation sources is the most desired system although it will be a time consuming activities need to be supported by the society. To implement the trying program so called waste generation source management, the more practical and promising methods are proposed as the procedures defined in the following subsections.

4.6.1 Control of Waste Generation

Waste generation control shall be focused on the flow of consumable goods from the activities of production, distribution, sale and consumption to reduce the waste generation potential in each process.

4.6.2 Control of Waste Discharge

Waste discharge control shall be practised to encourage self-disposal and recovery of materials at the waste generation sources to reduce the solid waste amount to be collected and disposed by NCC.

4.6.3 Recycling and Resource Recovery

Recycling and recovery of resources in the initial stage shall be conducted as a result of control of waste discharge control at the waste generation sources. Composting by the community base composting group shall be encouraged and assisted to prepare for installation of larger scale compost plant at proper time in future.

4.6.4 Implementation of the Programs

The proposed programs shall be carried out in cooperation with citizens and enterprises through legislative measures for control and public campaign by NCC and the central government that appeal to public moral and awareness to change the previous habit of the method of waste discharge. Necessary action plans are shown in **Figure G.4-2** and the details in **Figure G.4-3** for each programs of which shall be carried out by NCC, the central government and the people.

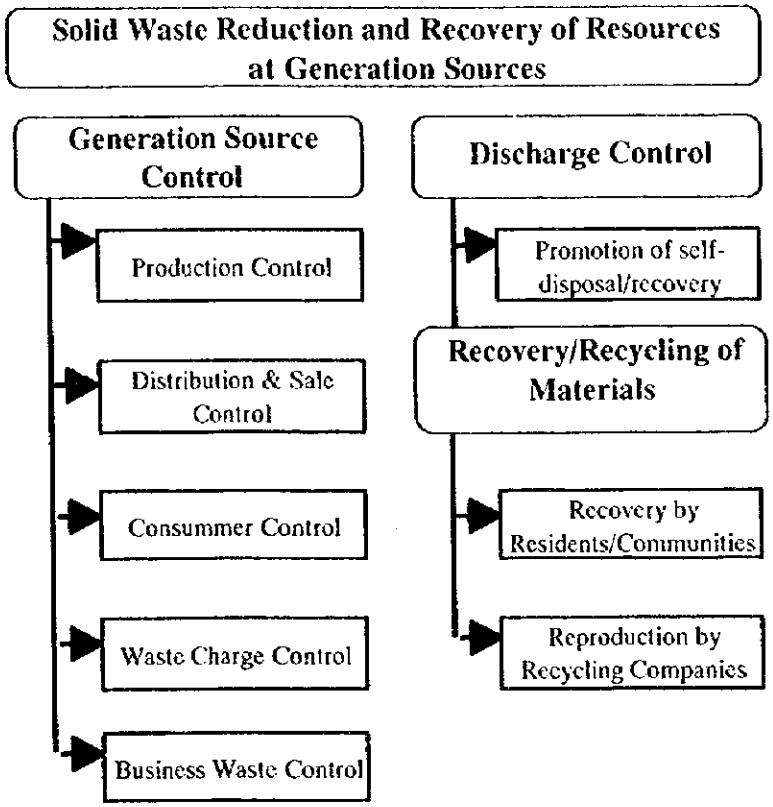
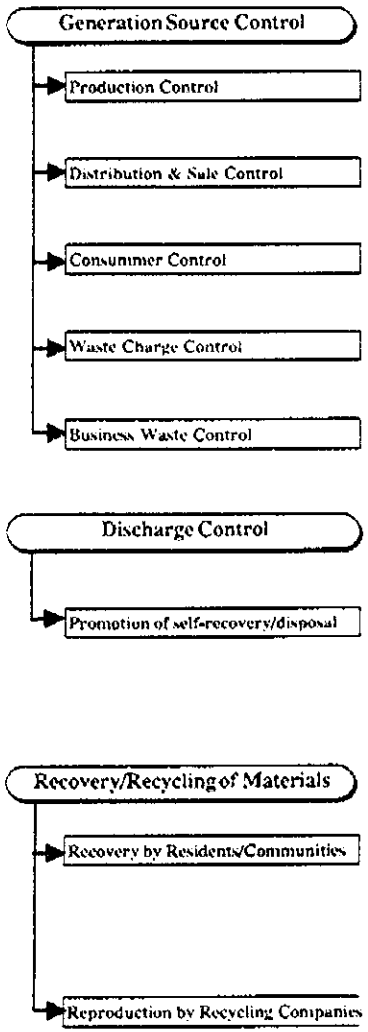


Figure G.4-2 Conceptual Flow of Waste Reduction and Recovery of Resources



	Planning Purposes	Actions by NCC/MOLG	Actions by residents/communities/enterprises
Generation Source Control			
Production Control	* Use of returnable bottles	* Encouragement/Assistance to makers	* Development/Production of returnable bottle goods
	* Use of eco-friendly goods	* Encouragement/Assistance to makers	* Development/Production of eco-friendly goods
Distribution & Sale Control	* Marketing of returnable bottle goods	* Control of non-returnable bottle goods	* Establishment of bottle deposit system
	* Reduction of packaging wastes	* Control of over-packaging goods	* Sale/Purchase of simple packaging goods
Consummer Control	* Reduction of domestic waste generation rate	* Save the Earth education	* Previous habit change
	* Reduction of waste shopping bags	* Campaign for reducuction of waste plastics	* Participation to use own shopping bag
Waste Charge Control	* Application of progressive waste charge rates	* Establishment of fair waste charge rates	* Payment by the large amount waste generators
	* Penalty to unpaid bills	* Billing and monitoring of unpaid bills	* Payment of the unpaid bills
Business Waste Control	* Reduction of business waste generation rate	* Public campaign/monitoring/control	* Participation to the SWM services
	* Application of progressive rates to business wastes	* Survey/Establishment of business waste charge rates	* Payment by the large amount waste generators
	Planning Purposes	**Actions by NCC/MOLG**	**Actions by residents/communities/enterprises**
Discharge Control			
Promotion of self-recovery/disposal	* Reduction of discharge amount at generation source	* Campaign for reduction of waste discharge amount	* Participation to SWM services
	* Composting by individual household	* Campaign for reduction/recycling of waste through composting	* Production of garden compost
	* Composting by community groups	* Encouragement/Assistance to community base groups	* Organization of community base groups
	* Reduction of broken appliances/instruments wastes	* Encouragemnt/Training/Introduction of repair technology	* Repair of broken appliances/devices and sales
	* Exchange/Sale of un-use articles	* Encouragement/Assistace for garage sales	* Organization of community base groups and operation
	Planning Purposes	**Actions by NCC/MOLG**	**Actions by residents/communities/enterprises**
Recovery/Recycling of Materials			
Recovery by Residents/Communities	* Establishment of the resource saving society	* Campaign for saving the resources	* Participation to the activities
	* Increase efficiency of resource recovery operation	* Classification for the types of recyclable materials	* Separation of recyclable materials at sources
	* Resource recovery from domestic wastes	* Encouragement/Assistance to residents/community groups	* Recovery of materials by residents/comunity groups
	* Resource recovery from business wastes	* Encouragement/Assistance to business establishments	* Recovery of resources at business establishments
	* Securing sales routes and income generation	* Encouragement/Assistance for buy-back centers	* Establishment/Operation of buy-back centers
Reproduction by Recycling Companies	* Involvement of recycling industries	* Encouragement/Assistance to recycling industries	* Development of recycling products
	* Regular collection by recycling companies	* Linkage/Encouragement for collection of recyclable materials	* Regular collection/purchase of materials
	* Recovery of waste materials	* Incentives to use recycled consumable goods	* Production of recycling goods

Figure G.4-3 Required Actions for Waste Reduction and Recovery of Resources

4.6.5 Example for Recovery of Waste Plastics

Waste plastics in Nairobi account for 15% more or less. The procedures for recycling and recovery of materials for waste plastics is introduced as the typical solid waste and because of nuisances in disposal.

Plastic wastes disposed of by landfill remain for many years without decompose and cause of the problems not only of environmental deterioration but also shorten the life of the landfill site due to its bulk density as commingled in the solid wastes. It is useful to separate and recover waste plastics at the generation sources to increase efficiency for collection and disposal operation.

Typical flow of plastic recycling is shown in **Figure G.4-4**. Most of the recycling companies use waste plastics recovered from the manufacturing processes of other plastic makers to avoid expenses for washing since it is required to use plastics recovered from Municipal Solid Waste. In other words, waste plastics recovered after the washing process will become valuables.

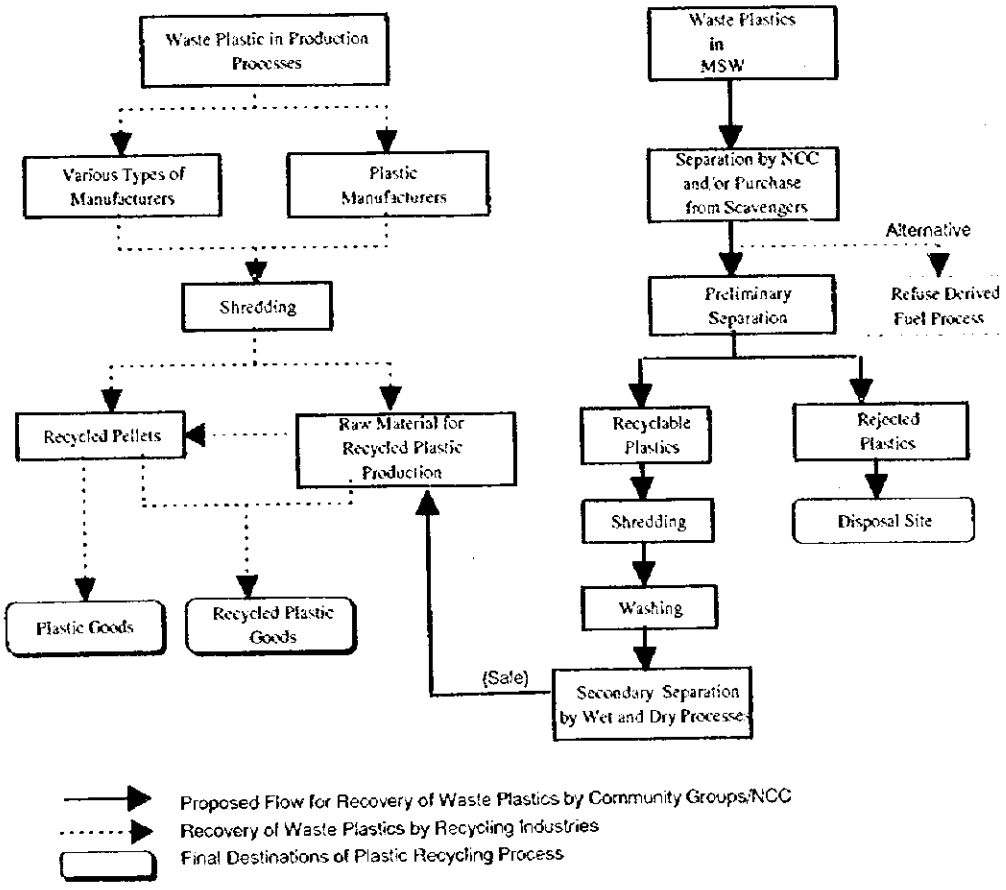


Figure G.4-4 Proposed Recycling Flow of Waste

4.7 Intermediate Treatment Plan

4.7.1 Timing for Construction of Intermediate Treatment Plant

The recent tendency of community needs generated from increased awareness of people for better environment has prompted local government bodies to install recycling and treatment facilities as a major process to compose the integrated solid waste management system in the developed countries.

However, due to probable financial burden to be caused by the large investment required for construction work, intermediate treatment facilities are generally installed in the last step of development of the integrated solid waste management system.

Considering the current financial problem of NCC to restrict implementation of the investment projects, investment for intermediate treatment facilities should be made after improvement of the financial condition of NCC, which is expected to be brought about through implementation of the proposed Master Plan.

4.7.2 Consideration of Intermediate Treatment Process

Introduction of solid waste separation at source is beneficial for operation of intermediate treatment facilities because of the benefit for resource recovery. NCC is responsible to establish, control and maintain the systems for participation of generators and separate collection for implementing separate collection in Nairobi.

Intermediate facilities will be installed after the processes of waste reduction and recovery of valuables. Several options are available nowadays in intermediate treatment processes including composting, bio-gas generation, incineration, refuse derived fuel (RDF), gassification and combination of each unit process.

Resource recovery through conversion of solid waste is made available depending upon the type of unit process adopted for intermediate treatment. Type of conversion products are compost, heat, electricity, solid fuel, fuel gas, etc. Optimisation study will be required to compose the treatment system in combination of unit process substantiated by the studies on demand projection, marketing of conversion products, future perspectives, etc., and financial assessment.

Waste composition analysis made in connection with the study measured the energy content of the average municipal waste generated in Nairobi. The values are in the range between 805 and 1,040 Kcal/kg in terms of lower calorific value obtained by the equation of two elements i.e. combustibles and moisture content and by measurement using laboratory calorimeter. These values are too low to consider installation of efficient waste incinerator for Nairobi. Result of the lower calorific value may be cause of higher food waste ratio commingled in the municipal waste and its property having more water content. Incineration treatment shall be studied again in future after improvement of the waste composition learned from sufficient data needed to be accumulated from now on.

In view of the circumstances of NCC required to give priority of the projects to forward financial strengthening programs, there is no option proposed to carry out the

project for installation of intermediate treatment facilities in this stage. However, installation of the intermediate treatment facilities is indispensable for establishment of the integrated solid waste management system for Nairobi in near future. On account of the situation, it is proposed to initiate the plan to direct toward installation of compost plant(s) in combination with incineration plant(s) which would be required in the later stage.

Compost demand is a key element to assure construction of compost plant and sustainability of the project. Accordingly, the potential demand of organic fertiliser or compost was studied under the following subsection to search the possibility for construction of the compost plant using the municipal waste.

4.7.3 Potential Demand of Compost

Compost is applied for soil conditioning effects contributed from increase of humus in soil. Effects of humus are well known to improve characteristics of soil that make it easier to till, increase moisture holding capacity, reduce leaching of chemical fertiliser, increase healthy biological activities in soil, etc., and increase productivity of crops as a combined result of application of compost.

Fluctuation of compost demand and storage, marketing system, attitudes of farmers for use of compost, etc., are the key elements in construction of compost plant. However, the most important factor is cultivation area to estimate potential compost demand. With regard to this factor, horticultural production area in the vicinity of Nairobi is presented in **Table G.4-7**. From the total production area in the table and assumption of application rate of organic fertiliser at 10 tons per hectare per year in average, total potential demand of organic fertiliser in the vicinity of Nairobi is estimated at approximately 1 million tons per year or 2,700 tons per day in terms of the amount of final products. Marketing and distribution of compost will be made hopefully through co-operation and utilisation of the function of Kenya Farmers Association (KFA) and Horticultural Crops Development Authority (HCDP).

Table G.4-7 Horticultural Production Area in the Vicinity of Nairobi

District	Data Year	Area (ha.)	District	Data Year	Area (ha.)
Machakos	1993	10,331	Embu	N. A.	1,019
Nakuru	1993	5,749	Kajiado	1993	967
Kiambu	1993	22,236	Nyadarua	N. A.	1,019
Makueni	1993	2,627	Laipikia	1993	354
Kakamega	1993	3,089	Taveta	1993	2,509
Nyeri	1991	6,366	Tana River	1993	1,914
Kericho	1993	1,767	Kwale	1993	11,593
Narok	1993	1,686	Mombasa	1993	7,106
Muranga	1993	4,590	Nyandarua	N. A.	1,019
Kirinyaga	1993	3,187	Limuru*	N. A.	159
Kirifi	1993	6,523	Kiambu	N. A.	16
Meru	1994	6,488	Total		102,313

* Indicate floriculture products

Data Source: *Horticultural Crops Development Authority (HCDP)*

4.7.4 Encouragement of Community Based Composting

Development of intermediate treatment facilities shall be carried out initially by encouraging and assisting the community base groups such as the 13 self-help groups organising the Nairobi Composting Committee Self-Help Group (NCCSG).

Their activities have started since 1995 initiated by the assistance program of the Foundation for Sustainable Development in Africa (FSDA) for community development but their activities have now become inactive due to the problem of land, marketing of compost, operation of composting work, working capital, etc. and requiring an external assistance and support from the public bodies such as NCC, provincial office and/or the other government agencies.

Existing compost yards operated by the composting groups are not always constructed to facilitate production of the compost of good quality. For promotion of composting by the community based groups and for improvement of the existing compost yards, the conceptual design of the compost yard was proposed for standardisation to make it easy for construction of the facilities.

In order to realise construction of larger scale compost plant, DoE have to pioneer the compost market through raising awareness of the farmers, securing storage and distribution system, etc. learned from the system of the community based composting groups. The community based composting, therefore, shall have a position to increase public awareness in municipal waste composting on behalf of DoE to enable construction of the pilot scale compost plant and forwarding to the actual scale compost plant in future. In this respect, DoE have to establish a strong links with the groups and support the activities by the community base composting groups.

4.7.5 Construction of Pilot Compost Plant

For development of intermediate facilities in future, the pilot compost plant of 50 tons capacity per day is proposed to be constructed waiting for financial improvement of NCC probably after 2008. Raw material for composting will be collected from organic wastes and food waste from hawkers markets, restaurants, hotels, etc., since solid waste from these sources contain more biodegradable waste and commingle almost no hazardous waste.

Future expansion of the facilities will be desirable to develop together with proper scale incineration plant to strengthen the functions of resource recovery and volume reduction before landfill.

4.8 Establishment of the Special Task Team

A special task team shall be established under the proposed Community Development Unit in DoE for implementation of waste reduction and resource recovery programs. A total of 18 staff shall be appointed comprised of a manager and two assistants for services in the central office and two special task officers each for six collection districts.

Also, one engineer and two assistant engineers shall be appointed for promotion of community based composting activities and study for implementation of intermediate treatment in the future and carry out the services in coordination with the said special task force for waste reduction and recycling operation.

4.9 Proposed Target Levels and Prospects

4.9.1 Proposed Target Level

It is suggested that implementation of the recycling and intermediate treatment plan shall be initiated with accumulation of database including waste amount, component, recycling activities, etc., to analyse installation of the proper facilities reflecting the needs of the society for recycling and intermediate treatment facilities. These data will be available through implementation of the improved solid waste management services to be proposed in the Master Plan and the priority projects in the coming 10 years.

The target level of waste reduction is proposed to realise the rate at 5% by 2008 and 10% within 10 to 15 years period by the waste amount at the generation sources.

The target level of material recycling and recovery is proposed at 5% by 2008 and 10% within 10 to 15 years period based on the waste amount counted from the amount after waste reduction at the generation sources.

The actions for development of the intermediate treatment facilities shall begin with keeping a good link with the community based composting groups to encourage, support and assist their activities for development of compost market in the future.

4.9.2 Estimated Amount of Waste Reduction and Resource Recovery

The recycling and intermediate treatment plan shall be implemented by the following four (4) steps:

The **first step** will be public campaigns by NCC/MOLG to develop social movement for waste reduction through participation of the residents, community base organisations, offices, factories and other business establishments. The waste reduction programme is expected to bring about waste reduction of 137 tons per day by realising the target ratio of 5% in 2008 as shown in **Table G.4-8** and **Figure G.4-5**.

The **second step** is separation of recyclable materials and recovery at the generation sources by campaigning participation of the community based organisations under the preparatory coordination by NCC/MOLG for securing market for the recycling materials through installation of the buy-back centres and cooperation by the recycling industries. Recycling is expected to have resource recovery of 125 tons per day by means of setting the target ratio of 5 % in the year 2008. The first and second steps are the main works proposed to execute continuously to expand the reduction and recovery ratios in future.

The **third step** is development of the pilot compost plant which may be executed in compliance with the needs and financial conditions of NCC. The pilot compost plant

with the capacity of 50 tons per day will be able to produce 25 tons of compost per day using selected green waste and kitchen waste while reducing waste amount by 25 tons per day. Amount of waste treated by the 15 community based composting groups is estimated at about 1 ton per day in terms of raw waste. The treatment amount will increase by the efforts of the groups through encouragement and support by NCC but the reduction amount or the recovery amount of waste is expected to take only a small portion of the whole amount of municipal waste.

The **fourth and final step** of resource recovery will be carried out by scavengers at disposal site. Basically, scavenging at the new landfill site(s) shall be prohibited. However, because of the difficulties to ban scavenging completely, it shall be operated flexibly under the control of NCC so that the scavenging will not obstruct the daily landfill operation.

The flow chart on **Figure G.4-5** shows the amount of waste amount reduction and resource recovery from generation to the final disposal assuming achievement of solid waste collection ratio of 100% and installation of pilot compost plant of 50 tons per day in 2008. The total amount of waste reduction at the disposal site is expected about 530 tons per day or 19% as compared with the potential generation amount including the amount of resource recovery. Meanwhile, the resource recovery itself is expected to recover the amount from 270 to 390 tons per day which is counted for between 10 to 14% through material recovery by the community groups, scavengers and biological conversion of the pilot compost plant.

Table G.4-8 Estimated Amount of Waste Reduction and Resource Recovery

Composition		Generation Amount (t/day)	Reduction at Sources		Discharge Amount (t/day)	Resource Recovery at Generation Sources	
			Target Reduction Ratio at Sources (%)	Reduction Amount at Sources (t/day)		Target Recovery Ratio (%)	Recovery Amount (t/day)
Food Waste		1,293	5	65	1,229	-	-
Paper	Recyclable	363	5	18	345	10	35
	Other Paper	71	5	4	68	-	-
Textile		67	5	3	64	-	-
Plastic	Container	118	5	6	112	20	22
	Other Plastics	179	5	9	170	10	17
Grass/Wood		168	5	8	160	-	-
Leather		23	5	1	21	-	-
Rubber		37	5	2	35	-	-
Organic Waste Subtotal		2,321	-	116	2,204	-	74
Glass	Container	81	5	4	77	20	15
	Others	43	5	2	41	20	8
Metal	Container	93	5	5	88	20	18
	Others	49	5	2	47	20	9
Others		143	5	7	136	-	-
Inorganic Waste Subtotal		410	-	20	389	-	51
Total		2,730	-	137	2,594	-	125

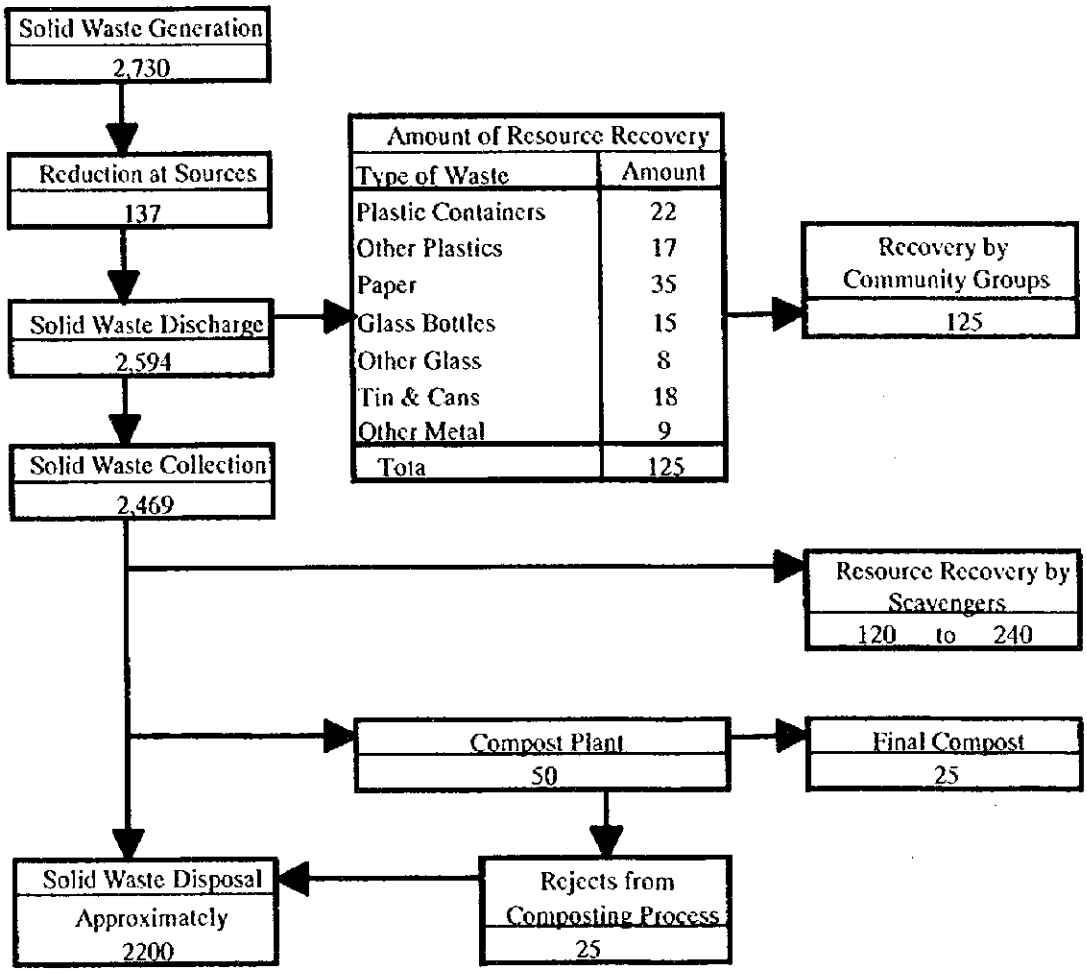


Figure G.4-5 Resource Recovery Flow and Amount in 2008 (t/day)

4.10 Recommendations of Recycling and Intermediate Treatment Plan

4.10.1 Waste Reduction

(1) Target

Target level of solid waste reduction ratio at the generation sources shall be realised at 5% and 10% by the year 2008 and within 10 to 15 years period, respectively.

(2) Action Programs in the First Implementation Stage

(a) Special Task Team shall be organised under the proposed Community Development Unit in DoE comprised of 21 staff to undertake waste reduction, resource recovery and intermediate treatment services.

(b) Waste reduction plan shall be carried out by means of the "Generation Source Control" and "Discharge Control" at the generation sources.

(c) The waste generation control shall be started with three measures, i.e., "Distribution & Sale Control", "Consumer Control", and "Waste Charge Control".

(d) Waste amount reduction through the waste Discharge Control shall be realised as a result of materials recovery by the community based groups and the recycling industries, and self-disposal at home.

(e) NCC shall execute public campaign and education owing to the most effective measures to encourage the people to change the previous habits on generation, discharge and recycling of wastes to promote participation of the public.

(3) Action Programs in the Second Implementation Stage

(a) The program of "Business Waste Control" shall be started for the "Generation Source Control" to reduce the generation amount from shops, markets, offices, institutional buildings, etc.

(b) Public campaign shall be made continuously addressed to the residents and business establishments.

(4) Action Programs in the Third Implementation Stage

(a) The program of "Production Control" shall be started to encourage factories to participate in the waste reduction movement.

(b) Public campaign shall be made for the factories to play a role in the waste reduction and continue the campaign to the residents and business establishments.

4.10.2 Recycling and Resource Recovery

(1) Target

Target level of waste recycling and resource recovery shall set at 5% by 2008 and 10% within 10 to 15 years, respectively, by means of materials recovery, reproduction and reuse through participation of the residents, community groups, institutions and business establishments.

(2) Action Programs in the First Implementation Stage

(a) A manager and two assistants of the Special Task Team shall be dispatched to each collection district office to implement the waste reduction and recycling activities.

(b) Waste recycling shall be started with the program of "Recovery by Residents/Communities" to separate and recover recyclable materials.

(c) DoE shall initiate the programs to establish the system for waste separation, collection, transportation, sale routes through the campaign to ask participation of the public.

(d) The women's groups as one of the community based groups will be best to facilitate separation and recovery of recyclable materials.

(e) Materials recovery shall be carried out for plastics, paper, glass and metals through the activities of the community based groups at the waste generation sources.

(f) Scavenging at the landfill site may be permitted as long as the activities of the scavengers is well under the control of DoE.

(g) NCC shall take proper measures to set up the buy-back centres where any individual can bring back recyclable materials in exchange for money.

(3) Action Programs in theSecond Implementation Stage

(a) The program of "Reproduction by Recycling Companies" shall be started to encourage the recycling industries for further development of the activities.

(b) NCC/MOLG shall take an action to encourage and assist the recycling industries to play an important role in further development of waste recycling activities.

(c) Public campaign and guidance shall be made especially addressed for the recycling industries.

(4) Action Programs in the Third Implementation Stage

(a) The public campaign, guidance and assistance shall be made continuously to develop the recycling activities.

(b) The system and the activities shall be reviewed to increase efficiency and effectiveness for further development of the activities.

4.10.3 Intermediate Treatment

(1) Target

DoE shall accumulate database, e.g., waste treatment technologies, compost demand and market, needs of the society and study toward establishment of the integrated solid waste management in the future.

(2) Action Programs in the First and Second Implementation Stage

(a) A manager and two assistants of the Special Task Team shall start servicing to have links between NCC and the community based compost groups to encourage and assist them for future expansion of their activities and expansion of the compost market.

(b) Raising awareness of the public for the benefits to use compost for farming and gardening through public campaign.

(4) Action Programs in the Third Implementation Stage

(a) Accumulation of database and analysis shall be made for reviewing the past activities and the needs for future development of the intermediate treatment facilities.

(b) NCC/MOLG shall start promotion of the pilot compost plant with the capacity of 50 tons per day to secure the financial sources to start operation in the possible earliest time.

(c) The engineering design shall be started, if required, based on the study to prepare for tender, construction and operation of the intermediate treatment facilities.