

Department for International Development

Contract Title

*Research Development and Design of a Simple
Solid Waste Incinerator,*

Contract No. CNTR 98 5698

Review of Demand and Selection of Partner Country

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1. INTRODUCTION

This report has been prepared in order to present progress to date on the review of demand for a low cost incinerator and the selection of a partner country in which to develop it and construct the pilot plant. It also sets out the data gathered and the observations made from a series of preliminary country visits and makes proposals for the content of the next visit to the proposed partner country

2. APPROACH

The purpose of this phase of the project was to identify whether small scale, low cost incineration (LCI) has a valid role to play in waste management in Medium and Low Income Countries (MLICs) and then to select a partner country in which to construct a pilot plant.

The process has been undertaken in two phases. In the first phase the need and demand for LCI in MLICs was assessed. It could be argued that the ToR assume the existence of both need and demand but a rigorous analysis requires that this first be demonstrated.

The second phase was then devoted to the identification of a suitable partner country.

A long list of countries was first prepared, providing a representative sample of developing countries of different types.

Data on these countries was obtained by means of existing knowledge and experience and desk research using published material, the Internet and telephone contacts. Demand and need was assessed. The countries were then evaluated and screened against a series of criteria to produce a short list of four potential partner countries, which were visited to obtain more detailed information on the sustainability of an LCI project.

The countries visited were then ranked in order of preference in terms of partnership potential.

3. ASSUMPTIONS

The following assumptions have been made in order to carry out the evaluation:

1. *The small scale incinerator will have a throughput of 10-20 tonnes per day*

This is an assumption in the ToR

2. *The cost to construct it will lie in the region of £10-20,000*

It is necessary to make some assumption about the cost, in order to assess affordability. The ToR states that the incinerator should be "low cost", although no specific sum was stated. In the proposal made by the contractors, however, this sum was provided. From subsequent country visits, it has been established that such a sum may be affordable in at least some countries, whilst significantly more is unlikely to be acceptable in many. Whilst this price level should not be considered at this stage to be an absolute limit, it forms a useful starting point.

It should be noted that, in the future, if LCE is marketed commercially, the selling price will need to be higher than cost, in order to provide a profit and cover the overheads of the company which markets and constructs it.

3. *This cost will be no more than that for an engineered landfill for an equivalent sized community*

A landfill to accept a similar waste tonnage for a period of, say, ten years is likely to cost £50-100,000, depending on the standard to which it is constructed. Indeed, a study recently completed for GTZ in Botswana¹ suggest that the costs could be as high as

¹ *Assistance with economic issues*, PLANCO GmbH, 1999
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£450,000, although we believe that this is an overestimate.

Recurring cash operating costs for the two systems are unlikely to be significantly different, so that the main difference in cost will be the initial capital outlay.

4. *LCI on the scale proposed will not create significant adverse environmental impacts*

An underlying assumption is that the plant will be designed so that the air emissions do not have a significant adverse effect on ambient air quality and that it will offer an improvement over a situation where open burning takes place.

The scale, however, is important. The actual emissions, as measured at the stack, are unlikely to meet the requirements of, for example, EU legislation – which has been designed with larger plants with greater volumes of emissions in mind. If a single larger plant of the type proposed were to be built, or several similar sized plants placed in the same location, however, it is likely that the overall air emissions will not be acceptable.

5. *The main component of the waste to be incinerated will be MSW*

In most MLICs, MSW presents the major waste management problem. There is no significant industrial waste because of the relatively low level of industrialisation and its proximity to human settlements.

6. *The plant will require a waste mix with a relatively high calorific value not unlike that of UK MSW in order to be self sustaining*

The Technical review has revealed that a number of previous MSW incineration projects have failed in countries where the CV of MSW was low, usually due to the high proportion of food and vegetable matter in the waste. It may be possible to mix some industrial wastes into the MSW, such as waste oil or sawdust, to raise the CV, if needed, provided that these wastes are available nearby and a suitable collection service exists.

4. SURVEY OF NEED AND DEMAND

4.1. Introduction

In the context of this project, *need* may be defined as the existence of problems which may be alleviated by the use of LCI. Need develops into *demand* when the problem is perceived to be significant and the country in question has an ability and willingness to finance the cost of providing LCI technology.

A review of a range of countries was carried out to establish the existence of need and demand..

4.2. Criteria

4.2.1. Need Criteria

The criteria used for establishing a need for LCI were:

1. *Open burning and uncontrolled dumping presents a major health hazard through degradation of water and air quality.*

Uncontrolled open burning of wastes produces dark smoke and odours. Worse, at the combustion temperatures which apply, emissions of dioxins, acid gases and even heavy metals may occur, presenting a significant health risk. It is also an accepted fact that uncontrolled dumping with no ground or surface water protection can lead to significant contamination of both surface and groundwater and a consequent health hazard. If open burning and uncontrolled dumping are taking place, therefore, it may be assumed that they will lead to health hazards.

2. *Sufficient communities exist producing waste at the rate of 10-20 tonnes per*

day to justify the development of LCI

It has been explained in assumption 4 above that that LCI is unlikely to be environmentally acceptable for large communities. It is therefore necessary to establish whether there are indeed sufficient communities producing waste at a rate suitable for the LCI plant. It will not be sufficient to provide LCI for a small part of a larger community.

The community for which it is provided must be self-contained and appreciably distant from others. Ideally, it should also have its own local government, rather than be part of a much larger administrative area, so that decision making takes place at the local level.

Typical MSW production in MLICs is around 0.35 – 0.6 kg/day. The relevant community size lies in the range of about 15-60,000, assuming that all waste is collected.

3. *The waste is collected and delivered to a central point*

Clearly, a reliable collection system is a prerequisite, to ensure that waste can readily be delivered to the plant. In theory, it is not important to the operation of the LCI plant whether the collection system collects all the waste produced in the community, provided that 10-20 tonnes is collected. In practice, however, the plant is unlikely to achieve a significant environmental amelioration unless it treats a high proportion of the total wasterequiring disposal.

4. *The cost of engineering controlled landfill, especially for smaller communities is prohibitively expensive*

Well engineered and controlled landfill may offer a better overall environmental impact than LCI, since the air emissions will probably be less harmful. Assumption 3 above suggests that controlled landfill will cost between two and ten times as much as LCI. For LCI to be needed, therefore, it must be demonstrated that some countries cannot afford controlled landfill.

5. *MSW must have a reasonably high CV or else suitable industrial waste (e.g. waste oil, timber etc.) must be available to improve the overall CV of the overall waste mix.*

Assumption 6 requires a relatively high CV for MSW or the existence of suitable industrial wastes to augment it. Countries with a need for LCI will therefore be required to demonstrate that the CV of MSW is not low or that suitable industrial waste streams exist for which a collection system exists and which do not have an acceptable alternative disposal outlet.

4.2.2. *Demand Criteria*

The criteria used to establish the existence of demand were:

1. *An awareness of health and environment issues in government and the general population*

If a need for LCI is to be perceived, there must be an awareness of health and environment issues. This may be measured by, for example, the existence of existing projects on waste management.. Another measure would be the existence or imminent development of legislation relating to waste management and the environment.

2. *Acceptability of LCI*

Having established the existence of environmental awareness, it is important to determine whether existing disposal methods are perceived to be polluting and whether therefore measures such as LCI which reduce this pollution would be welcomed.

3. *LCI is affordable*

It is more difficult to assess whether LCI is affordable in a desk study. This generally requires face-to-face meetings with relevant officials. If waste is being managed at all, even at an uncontrolled landfill, the recurrent operating costs will consist mainly of labour and perhaps some small items of plant. The recurrent operating costs for LCI will

not be very much greater, except for the provision of some support fuel for reaching the operating temperature. The main affordability issue, therefore, relates to the capital cost. It is therefore necessary to assess whether communities are likely to be able to afford to invest about £10-20,000 in improving waste management standards.

4.3. Review of Need

A representative sample of MLICs in three basic geographical locations were investigated to establish whether a need for LCI existed. The main region not considered was South America, largely because of language difficulties. This was done by determining whether each of the five criteria identified in section 4.2.1 were fulfilled. In some cases, uncertainty existed, which is depicted by a question mark. Table 4.1 shows the results of this analysis.

Country	Burning/ Dumping	Community Size	Collection	Landfill too expensive	MSW CV	NEED
Caribbean						
Antigua	✓	?	✓	✗	?	✗
Grenada	✓	?	✓	✗	?	✗
Jamaica	✓	✓	✓	✗	?	✗
St Lucia	✓	?	✓	✗	?	✗
St Vincent	✓	?	✓	✗	?	✗
Trinidad	✓	✓	✓	?	?	?
Asia						
Bangladesh	✓	✓	✓	✓	✗	✗
India	✓	✓	✓	✓?	✗	✗
Indonesia	✓	✓	✓	✓?	✗	✗
Malaysia	✓	✓	✓	✗	✗	✗
Nepal	✓	✓	✓	✓	✗	✗
Philippines	✓	✓	✓	✓?	✗	✗
Sri Lanka	✓	✓	✓	✓?	✗	✗
Africa/M East						
Botswana	✓	✓	✓	✗	✓	✗
Egypt	✓	✓	✓	✓?	✓?	✓?
Eritrea	✓	✓	✓	✓	✓	✓
Ghana	✓	✓	✓	✓	✓?	✓?
Kenya	✓	✓	✓	✓	✓	✓
Malawi	✓	✓	✓	✓	✓?	✓?
Morocco	✓	✓	✓	✓?	✓?	✓?
Palestine	✓	✓	✓	✓?	✓?	✓?
Tanzania	✓	✓	✓	✓	✓	✓
The Gambia	✓	✓	✓	✓	✓?	✓?
Zimbabwe	✓	✓	✓	✓	✓	✓

In the West Indies, many islands are currently in the process of constructing engineered landfills. Advice from DFID also pointed out that, being close to the USA, it is unlikely that governments would have much interest in incineration without stringent emission controls.

Countries in the Indian sub-continent were initially believed to be good candidates for the use of LCI, partly because of the high population density and consequent pressure on land use. We received strong views from Government,

however, that the waste composition was totally unsuitable and a low level of interest was shown in the project. In Sri Lanka, for example, food and vegetable matter makes up 80% of the MSW stream. This is partly due to the activities of the informal sector in recovering recyclables before the waste is disposed of.

Table 4.1 shows that the West Indian and Asian countries may not be able to demonstrate a valid need for LCI. In the event that, by testing, it may be demonstrated that low CV wastes can be burnt in an LCI plant, then the Asian countries would be able to demonstrate a need for the technology. In Africa, however, a need can be shown to exist in several countries. The same is likely to be true in some of the poorer countries of the Middle East.

4.4. Review of Demand

It is more difficult to establish the existence of demand from a desk study, as it is only really possible to obtain a valid impression by visiting the country. From the information which was possible to obtain, together with the previous experience of the Consultants, those countries which may have demonstrated a need were then evaluated in terms of the potential demand for LCI. The results are shown in Table 4.2.

Country	Environmental Awareness	Acceptability	Affordability	DEMAND
Egypt	✓	?	✓	✓?
Eritrea	✓	✓	?	✓?
Ghana	✓	✓	✓	✓
Kenya	✓	✓	✓	✓
Malawi	✓	✓	✓	✓
Morocco	✓	?	✓	✓?
Palestine	✓	?	✓?	✓?
Tanzania	✓	✓	✓	✓
The Gambia	✓	✓	✓	✓
Zimbabwe	✓	✓	✓	✓

It may be deduced from the table that demand probably exists in all the countries where a need has been identified. If the technology proves to be suitable for lower CV wastes, demand may also exist in some of the Asian countries.

5. SELECTION OF PARTNER COUNTRY

5.1. Introduction

The countries in which a demand was identified as being expected to exist were then reviewed in order to select a short list of four countries to be visited to evaluate demand in greater detail. The candidate country which offered the greatest potential for a sustainable LCI was then identified as the recommended partner country for the pilot project.

5.2. Criteria

The key criterion for selecting the short list was that the central government of the country - in the form of the ministry responsible for waste management issues - showed a *positive interest in participating* in the project. One measure of the degree of interest was whether they were prepared to set up a visit programme.

A number of other criteria, however, were also considered. These are described below with appropriate comments:

Political Factors

There are two aspects to this: stability and integrity. It is felt that due to the relatively long time period of this project, it would be unwise to select countries where the outlook for political stability is particularly poor. The issue of integrity is also important. It is known that, in some countries, corruption is a significant feature, especially at local government level. This could lead to problems of a practical nature during the implementation of the project.

DFID advice

Although this project is aimed at knowledge and research, rather than bilateral aid, the advice of local DFID offices has been sought before short-listing candidate countries, to ascertain whether the project fits with DFID's local strategy.

English Language Capability

Whilst it is the intention to make the technology developed during this project available to any country which wishes to use it, it must be recognised that, from a practical point of view, it will make the task of constructing and operating the pilot plant considerably easier and less costly if it is possible to work without the need for interpreters. As a consequence, it has been decided to select countries where English is widely spoken.

5.3. Selection Process

The short list selection process took place in a number of stages, as follows:

Stage 1 – Screening of Long List

A wide range of MLICs in most parts of the world was initially selected, to reflect differences of size, geographic characteristics, climate and population density. A number were rejected due to the inability to make appropriate contacts, in some cases due to language difficulties. This list was then screened during the analysis of need and demand, to produce a shorter list of those countries where a possible demand existed.

Stage 2 – Political Factors

Those countries where there was known political instability were eliminated.

Stage 3 - DFID Advice

Countries where advice from DFID indicated particular potential for political instability or that the project did not fit with DFID's strategy were eliminated.

Stage 4 – Language

It was determined that the sample could be reduced in size but remain broadly representative by eliminating countries which did not have English as a major language.

Stage 5 - Scoring and Selection

Having eliminated countries which failed any one of the three screening tests applied, the remaining countries were contacted to establish whether they would organise a visit programme. In one case (Egypt) no contact could be made within

the timescale. The others all initially agreed to organise a programme, but Tanzania failed to do so. This left the desired short list of four countries.

5.4. Results

Table 3 shows the countries considered and the results of the selection process.

Country	Political Stability	DFID Advice	Language	Visit Programme
Egypt	✓	✓	✓	
Eritrea	✗	✓	✓	
Ghana	✓	✗	✓	
Kenya	✓	✓	✓	✓
Malawi	✓	✓	✓	✓
Morocco	✓	✓	✗	
Palestine	✗	✗	✓	
Tanzania	✓	✓	✓	
The Gambia	✓	✓	✓	✓
Zimbabwe	✓	✓	✓	✓

The short list of countries selected was:

- Zimbabwe
- Kenya
- The Gambia
- Malawi

6. SHORT LIST EVALUATION

6.1. Overview

The short listed countries were visited for periods of some three days each, in order to establish further detail about the situation in each. A clear preference emerged for the partner country, as will be seen, but some of the other countries visited also appeared to be promising candidates for future use of the technology and displayed a keen interest. This indicates that there is strong potential for replication – in Africa at least. Proposals are therefore included for the maintenance of the momentum generated to maximise the replication opportunities.

The main purpose of the country visits was to identify a suitable municipality in which to construct the pilot plant and to gather as much relevant information as possible about the countries visited in the time available. In each country, recommendations for selection of suitable municipalities were accepted from the responsible central government ministry - in most cases the Ministry of Local Government. The recommended municipalities were then visited, to assess their suitability for locating the pilot plant.

Information was sought on the following topics:

- Regional Characteristics
 - Population
 - GDP/capita:
 - Pay levels
 - Climate

- Land use
- Water resources
- Industry
- Materials availability
- Existing manufacture of incinerators
- Air and water testing facilities
- Status of Waste Management
 - Waste quantities
 - Waste composition
 - Formal or informal strategies and plans
 - Existing waste management projects
 - Organisational arrangements for managing wastes
 - Waste minimisation and recycling
 - Storage and collection
 - Disposal methods
 - Legislation and Enforcement
 - Specific Situations in municipalities visited
- Government Attitudes - importance attached to waste management standards
- Public Perceptions and Attitudes
 - Level of concern about waste management
 - Level of awareness and concern about incineration
 - Activities of Environmental NGOs
- Financial Issues and Constraints
 - Arrangements for financing and recovering the costs of waste management
 - Role of private sector
- Attitudes to increasing expenditure on waste management
- Commitment to Project
 - Central Government
 - Local Government
 - Potential partners

6.2. Ideal Characteristics of Partner Country and Ranking Criteria

The characteristics sought for a suitable country in which an incinerator project would be feasible and sustainable were:

- A clear indication from Government, at central and local level, to take ownership of the project.
- Existing reliance on uncontrolled dumping and/or open burning as a disposal method by local authorities. (This term is used extensively hereafter. It should not be confused with “fly-tipping”, which is an activity by waste generators which is independent of any facilities provided by the authorities.).
- MSW with a composition indicating a relatively high CV likely to be self supporting for incineration
- A high quality of management in the selected municipality
- A willingness on the part of central and/or local government to invest in the improvement of the environmental quality of waste management services
- The existence of a system for recovery from the general public of the cost of

MSW management

- A high degree of reliability in the provision of the MSW collection service
- Existence of suitable local manufacturing partners
- Existence of a local manufacturing base to enable ready access to the materials and supplies necessary for the construction and development of an incinerator.

A multi-criteria analysis approach was therefore taken to selection of the partner country. The criteria used, together with the weighting applied to each is shown in Table 6.1.

Table 6.1: Criteria for selection of Partner Country

Criterion	Weighting
Willingness to take ownership at central and local government level	10
Degree of existing reliance on uncontrolled dumping	10
Waste composition	10
Quality of management at selected municipality	10
Willingness to invest in waste management improvements	10
Existence of cost recovery mechanisms	5
Quality of refuse collection service in selected municipality	5
Existence of suitable local manufacturing partners	5
Depth of general manufacturing base/availability of supplies	5

These criteria were used for the selection of a partner country from the short list. The major characteristics of the countries visited is shown below.

6.3. Results

The detailed results of the data gathering exercise in each country visited is shown in the Country Reviews in Appendix I. A brief summary of the conclusions reached relating to need, demand and suitability as a partner country is given in the following sections.

6.3.1. Kenya

In Kenya, the Ministry of Environment showed some interest in the project, although they made it clear that it was not likely to solve their most pressing problem, which relates to the larger towns. All MSW disposal is undertaken by means of uncontrolled dumping. The waste did not have a very high proportion of food and vegetable matter, but there was a relatively large amount of dust from street sweeping. Of the two municipalities visited, one was too large and the other too small. neither had any significant grasp of waste management techniques. There was also a severe shortage of finance, so that the likelihood of future investment in waste management facilities was relatively low. MSW collection was rather poor in quality and reliability. A local incinerator manufacturer exists, which could be a good local partner.

6.3.2. Malawi

~~Malawi is a very poor country indeed. The Ministry showed a strong interest in~~

the project, although this appeared to be because of the perceived aid finance rather than for the intrinsic value of the project. Disposal of all waste is by uncontrolled dumping. The waste did contain a relatively high proportion of food and vegetable matter. The only municipality visited was the capital, Lilongwe. We were informed that Zomba - a smaller town - might be more suitable, but was similar. The municipal management team was not impressive and, again, there is clearly a very acute shortage of finance. The collection system was relatively well managed. No potential local partners were identified and the country has a small industrial base.

6.3.3. Zimbabwe

Zimbabwe showed great enthusiasm for the project, at both central and local government levels. Furthermore, there was a clear understanding of its benefits and an impression that other towns might wish to replicate the system, when it is proven to be effective. Waste disposal is by uncontrolled dumping. In Harare, this is causing significant political problems.

The waste composition, especially in the selected municipality (Marondera), appears to indicate a high CV. A preliminary analysis of a single refuse collection vehicle has now been undertaken, showing 36% by weight of paper and board and 14% of plastics. This municipality also has a good appreciation of waste management issues and the Senior Environmental Health Officer has a masters degree in environmental health, having studied waste management as part of this course. He is also extremely enthusiastic about the project. The collection system is efficient and a new vehicle has recently been purchased. A cost recovery system is in place (Zim\$33/household) which appears to cover the entire cost of the current level of service provision, even allowing for only 70% actual payment.

Time was not available to visit potential manufacturing partners, but it is believed that they exist – foundry manufacturers being particularly interesting candidates

6.3.4. The Gambia

The small land area of The Gambia means that the country has a very real need for improving the quality of waste management. This is particularly true in Banjul where space for landfill is physically limited by the confines of the island within the river estuary.

Representatives within the National Environment Agency of The Gambia showed great enthusiasm for the project. Unlike the other countries visited, it has prepared a waste management strategy – which demonstrates its commitment to improving standards. Local authorities also showed enthusiasm provided it could be demonstrated that LCI was an appropriate solution to their MSW disposal problems. The waste composition is currently being analysed, but it is unlikely to possess such a high CV as that in Zimbabwe.

There is a strong institutional framework of stakeholders in existence which would help ensure the success of a pilot project. The public works agency, GAMWORKS, which receives funding from the World Bank, could be a useful local manufacturing partner.

6.4. Conclusions and Ranking of Potential Partner Countries

Potential for the use of a low cost incinerator exists in at least three of the four countries visited – Zimbabwe, The Gambia and Kenya. In Malawi, the waste composition indicates that composting is more likely to be the most suitable technique. In order to select the most suitable partner country, however, the countries were ranked in order of suitability. The outcome of the ranking exercise is shown in Table 6.2 below.

Table 6.2: Ranking of Partner Country Candidates

Criterion	Kenya	Malawi	Zimbabwe	Gambia
Willingness to take ownership at central/local government level (10)	7	5	9	9
Degree of existing reliance on uncontrolled dumping (10)	10	10	10	10
Waste composition (10)	8	5	10	7
Quality of management at selected municipality (10)	5	5	9	7
Willingness to invest in waste management improvements (10)	5	3	10	5
Existence of cost recovery mechanisms (5)	0	0	3	0
Quality of refuse collection service in selected municipality (5)	2	4	5	3
Existence of suitable local manufacturing partners (5)	5	2	4	4
Depth of existing manufacturing base and availability of supplies (5)	4	2	5	4
TOTAL	49	36	65	49

It seems clear from Table 6.2 that Zimbabwe will be the best choice as partner country and it is recommended that Zimbabwe be selected..

6.5. Proposed Actions to Encourage Replication

The visits generated some enthusiasm for the project in all four countries. In order to maintain this momentum, it is proposed that a working group be formed of all four short listed countries and that a representative from each be kept informed of progress on the project by means of regular newsletters, possibly via the Internet, so that other countries could readily be brought into the group and questions could be answered. If the incinerator manufacturer in Kenya is interested, it might be possible to involve it more intensively - for example by financing a visit to the pilot plant when it is operational.

In addition, in Zimbabwe, where there appears to be a very real chance of replication in other municipalities, it is proposed that a country working group is formed with representatives from as many municipalities as may be interested. This group should hold meetings on site to observe the plant in action and be kept informed of progress. These municipalities should also be represented at the objective definition workshop.

7. FURTHER RECOMMENDATIONS

7.1. Design Implications

7.1.1. Capacity and Working Hours

Whilst continuous 24 hour working would be ideal, it is unlikely to be practical in many small municipalities in developing countries, because supervision is unlikely to be available. It would therefore seem that the plant must be designed to be operated on one shift only and fired up each morning. This is, of course, far

from ideal and should be avoided if possible.

Municipalities using the plant will, of course vary in size and the plant will need to be flexible in order to have a relatively universal applicability. There are therefore two approaches - a family of designs can be developed, depending on waste volumes, or a standard plant with a capacity of about 10 tonnes in a shift can be developed, the capacity of which can be increased by adding a second or even third shift. These extra shifts will only be necessary in larger municipalities, where they may be more practical.

7.1.2. Waste Composition

The partner municipality has been selected as one which has a waste composition which appears to be readily combustible. Other countries have higher proportions of food waste and hence a lower CV. The plant should therefore be tested with waste mixtures having higher proportion of food waste (for example by adding waste from nearby farms) to establish at what minimum CV (or waste composition) it will still operate.

7.1.3. Power Supply

Although it is likely that a power supply will be available at the location selected in Marondera, it is recommended that the plant be designed to have the ability to operate using a generator, since in some locations, power may be unreliable or not readily available. Installing the connection may cost a similar amount to that for a generator. Operating costs, however, are likely to be higher, so that, if possible, the pilot plant should be mains powered.

7.1.4. Backup Disposal

When the plant is operational, the only waste requiring disposal will be the ash. It is most likely, however, that there will be periods of down-time for maintenance etc., so it is important to recognise that, on occasions, unburnt waste will still need to be landfilled (or dumped).

7.2. Other Recommendations

7.2.1. Communications

Local authorities do not, in general, have email connections, although they do have computers. It is suggested that the project should pay for an email connection for the selected partner municipality.

A mobile phone with a connection to the Zimbabwe system will be important for the engineers working on the plant.

7.2.2. Local consultancy

Local consultants will be required to carry out the EIAs. In addition, however, it is suggested that small contracts also be awarded to the Blair Institute (Ministry of Health) and the University of Zimbabwe Mechanical Engineering Department, in order to promote the project and its replication. Both of these organisations may be able to assist in the EIA, but additional expertise may be required.

8. FURTHER WORK BY LOCAL CONSULTANTS

8.1. Kenya

ITDG Kenya has been commissioned to obtain further details about the local

incinerator manufacturer and the plant that has been identified (see Appendix I). They will also carry out a waste analysis at Limuru. Due to unforeseen problems in Nairobi, the results are not yet available.

8.2. Malawi

A member of the Ministry of Environment staff has been commissioned to carry out a waste analysis in Lilongwe. No results have yet been received.

8.3. Zimbabwe

ITDG Zimbabwe has been commissioned to carry out a waste analysis at Marondera, the results of which are now available and have been incorporated into this report.

8.4. The Gambia

A member of the National Environment Agency staff has been commissioned to carry out a waste analysis in Banjul and Kinafing. The results are not yet available, however.

9. PROGRAMME FOR NEXT VISIT

Assuming that confirmation of Zimbabwe as the partner country is forthcoming, it is proposed that the next visit will take place in late May/early June 1999. The main objectives of this visit will be to verify the assumptions identified in the log frame in Annex 1 and, specifically:

Further general background data gathering

Assurances of Commitment from Central and Local Government

- To obtain written commitment from central government and the partner municipality to making resources available for the project – including land and utilities
- Determine, in conjunction with the partner municipality, the staffing requirements for the plant (as well as can be achieved at this stage) and obtain written assurances that they will be made available
- To estimate the likely increase in cost recovery necessary to fund the operation of the incinerator and the feasibility of achieving the increase

Selection of Manufacturing Partner.

- This would be done in a transparent manner through contact with the local Chamber of Commerce but, for the success of the project, it is vital that we have the final say in the selection process. Representatives of the manufacturer or collaborating technical institution are to be invited to participate in the design phase in the UK if funds allow – possibly through the British Council.

Technical Aspects

- To assess further the locally available skills and capabilities.
- To assess further locally available technologies and fabrication methods.
- To determine the availability of suitable support fuels.
- To identify whether there is a significant proportion of particularly

contaminating wastes (e.g. PVC, rubber, batteries) which will require segregation.

- To identify local design requirements.

Selection of local consultants to:

- carry out “do nothing” EIA
- provide technical support
- encourage implementation and replication

Workshop

- To hold a problem/objective analysis workshop with all stakeholders in order to finalise detailed project objectives and log frame.

The workshop will be an especially important feature of the visit. We have some experience of the kind of questions that may be asked after a similar workshop was held in The Gambia during the initial visit. The following major issues arose and were addressed during that workshop:

- The need to ensure an full understanding that this is a research project which is designed to meet local needs, but is also expected to generate information useful for other communities and countries.
- The need to explain the design and development process for the incinerator, including the use of the test rig in the UK.
- The need to explain that existing, “off the shelf” technology is not necessarily appropriate for an LCI plant of this kind.
- There is a keen interest in the potential for energy recovery, but little technical understanding of the inherent economics.
- There is a strong interest in continued involvement with the project even if the pilot plant is built elsewhere.
- Concern about co-financing.

Appendix 1 – Country Reviews

LOW COST WASTE INCINERATOR

COUNTRY REVIEW - KENYA

REGIONAL CHARACTERISTICS

Demographic and socio-economic characteristics

Population : 26 million, 26% urban, 48/km⁵

GDP/capita: \$270

Pay levels

Labourers

Junior Managers

Graduate Engineers

Unemployment

Unemployment is substantial. For example, graduates of the university are unable to find skilled work and have to resort to unskilled tasks such as refuse collection.

Climate

The rainfall around Nairobi is about 1800 mm. The dry season is between April and October.

Land use

Land is quite intensively cultivated for agriculture. There are also quite large areas of forest. Making land available for landfills, however, does not appear to present a major problem except near the large cities, where one particular problem is the rapid population growth and urban sprawl. This leads to landfills which were commenced outside cities (e.g. Nairobi, Mombasa) becoming surrounded by housing and squatter settlements.

Water resources

Surface water provides the main source of water supply, although boreholes are used in some rural areas. Waste water treatment is available in the larger cities, but the systems are overloaded. Smaller towns have no treatment facilities.

Industry

General

Kenya has, in regional terms, a significant industrial base, with oil refining, chemical and pharmaceutical manufacture, cement, steel rolling mills, a foundry (Kenya Railways) etc.

Engineering

A number of construction and engineering companies exist

Bricks

Bricks are manufactured but not, as far as is known, refractory bricks.

Materials availability

Mild steel - angle, channel, tube, sheet, plate

Stainless steel

Electrical motors and switchgear

Refractory materials

Manufacture of incinerators

A local incinerator manufacturer exists in Nairobi. A plant was manufactured for the Bata shoe company at Limuru. This plant is of steel construction and has water scrubbing for SO_x.

Technical facilities

The University of Nairobi has all the expected facilities of a significant university.

Air and water testing facilities

The University of Nairobi Chemistry Department carries out air sample analyses - for particulates, SO_x, etc. It can also carry out water sample analysis.

STATUS OF WASTE MANAGEMENT

Waste quantities

There are no statistics for total production of wastes in Kenya. A study on MSW in Nairobi (see below), however, produced the following waste generation statistics:

Source	Quantity	Density CV (KCal/Kg)	
Restaurants	6.79 kg/day	0.28	1630
Other commercial	1.39 kg/day	0.26	1692
High income households	0.654 kg/person/day	0.30	1233
Middle income households	0.595 kg/person/day	0.26	1349
Low income households	0.552 kg/person/day	0.28	630
Markets	2.425 kg/day	0.38	1427
Road sweepings	48.3 kg/km	0.23	n/a
Average		0.28	1032

The difference in CV between low and higher income households is particularly noticeable.

The total MSW production in Nairobi was projected as follows:

Shops and restaurants	94 t/day
Houses	1285 t/day
Markets	82 t/day
Road sweepings	69 t/day

The oil industry estimates that 27,000 tonnes of oil waste are produced from motor vehicles. About 6,000 tonnes is recycled and more is used as fuel.

Waste composition

The same study estimated the composition of MSW as follows:

Material	Average	High income	Low income
Food	51.5%	50%	57%
Paper	17.3%	17%	16%
Textiles	2.7%	3%	2%
Plastic	11.8%	14%	12%
Grass/wood	6.7%	8%	2%
Leather	0.9%	1%	1%
Rubber	1.5%	1%	2%
Glass	2.3%	2%	2%
Cans	1.7%	2%	1%
Other metal	0.9%	1%	0%
Other	2.7%	7%	4%

What is notable is that most beverages are sold in returnable bottles, which accounts for the low proportion of glass and cans. The use of cans is stated to be on the increase. It is notable that the difference in composition between high and low income is not very great. From observation, however, it appears that in many MSW samples, the proportion of dust and fines is substantially greater than shown in the above analysis, which should therefore be treated with caution.

The following information was also calculated:

Moisture	64.2%
Ash	8.9%
Combustible	26.8%
C	49.33%
H	5.45%
N	1.22%
S	0.14%
Cl	0.21%
O	43.75%

Impacts from waste-related pollution

Formal or informal strategies and plans

There is no formal waste management strategy. The Ministry of Environment expressed the view that engineered landfill was extremely expensive.

Existing waste management projects

The World Bank funded the preparation of the National Environmental Action Plan, which contains some aspects on waste management.

JICA funded the preparation of a waste management master plan for Nairobi (A Study on Solid Waste Management in Nairobi City@), which was carried out by CTI Engineering Company Limited and Environmental Technology Consultants Limited (with some participation by Integrated Skills limited). To date, none of the recommendations have been implemented due to lack of available finance.

Organisational arrangements for managing wastes

Municipalities are responsible for managing MSW, including commercial wastes. The private sector handles industrial wastes.

Waste minimisation and recycling

In the major cities, Nairobi and Mombasa, paper, cans, glass and plastic bottles are collected for recycling by private businesses or individuals. There is no such service in the smaller towns.

Some 6,000 tonnes of waste oils are recycled in Kenya, out of a total of 27,000 tonnes. Waste oils are also used as fuel and for wood preservation. The recycling process, however, produces acid tars and the Oil Industry Waste Management Committee are not comfortable with this. They are negotiating for cement kilns to use the oils as secondary fuel. The agrochemical industry have also used cement kilns and are currently negotiating Lomé IV financing to incinerate the existing stockpile of about 100 tonnes. This has been arranged by GIFAP, the international trade association, which has its African headquarters for the Safe Use Programme in Nairobi.

Storage and collection

Individual household waste containers are only present at higher and middle income households. Low income households make use of communal containers or dumping stations - where waste is hand loaded into vehicles. Some dumping stations are constructed of concrete but others are just informal piles, which are sometimes burnt.

The vehicles may be tractor/trailers, open tippers, roll-ons or compaction vehicles, depending on the size of the city. Typical payloads are 2-3 tonnes. Vehicles are not covered and plastic/paper blows away during transit. A study¹ shows that, in 1996, 50% of the Nairobi City Council refuse collection vehicles were non-operational at any one time.

It is estimated in the 1997 JICA study that only some 25% of the waste in Nairobi is collected. In an alternative study, undertaken by UNCHS in 1997², however, that 90% is collected. This study assumes daily arisings of 1000 tonnes, against 1530 tonnes in the JICA study. If the JICA figures are used this would give a collection percentage of about 60%. Nairobi City figures for 1996 suggest that 50% was collected. There is little visible evidence to suggest that the JICA figure is correct. The remainder that is not collected is dumped and frequently burnt.

In Mombasa, the mayor took a strong initiative to clean up the city of garbage, but he has recently resigned.

In Nairobi, 60% of waste collection is performed by the private sector, which offers a more reliable service, for which a fee of Ks 200/household/month is charged. Many of these private firms fly-tip the waste. In Nakuru, a charge is made to private collectors for using the city dump. This exacerbates the fly-tipping problem.

In Nairobi, according to the JICA study, the Council collects about 80 t/d of which 91% is from stations and 9% door-ro-door. Private contractors collect about 115 t/d split 48%/52%. The UNCHS

²

Privatisation of Municipal Services in East Africa, UNCHS, 1997

study quotes figures of 400 t/d and 500 t/d. The JICA study contests these figures. The central business district (CBD) collection is contracted out (to Kenya Refuse Handlers Ltd.). Two thirds of CBD industrial waste producers handle their own solid waste, mainly by selling to scavengers.

Disposal methods

There are no controlled landfills in Kenya and complete reliance is placed on open uncontrolled and burning.

The main MSW dump site serving Nairobi is located at Dandora. This is totally uncontrolled and burning. It covers about 26.5 Ha and is estimated to contain some 1.3 million m³ of waste. Many scavengers are present and tannery sludges, hospital waste including used syringes and other industrial wastes can be observed.

The situation in smaller towns is similar, although the proportion of waste collected may be even lower.

Legislation and Enforcement

There is currently no specific legislation on waste management or, yet, on the environment. Kenya currently relies on the Public Health Act (cap 242) and the Local Government Act. Effluent discharge guidelines are set by local authorities. An Environmental Management and Co-ordination Bill received its first reading in Parliament in 1996, but progress has been slow. A new version is to be presented soon but copies are not yet available. It will require EIAs for new developments, will establish a National Environmental Management Agency and will require licensing for waste management facilities. It will also introduce air quality standards but not, we understand, emission standards. It may be published shortly.

Currently, with the lack of legislation, there is little enforcement of waste management standards. Such enforcement as does exist is undertaken by local authorities under the Public Health Act. For example, a waste incinerator at a shoe factory was closed down for production of smoke and a factory discharging heavy metals which caused a sewage works to cease functioning was closed down until a treatment plant was constructed.

The Ministry of Environmental Conservation consists of three sections: Mines and Geology, Forestry and the National Environmental Secretariat. The Secretariat covers pollution control (wastes), EIAs, resource management, planning and education.

There is currently no formal consultation about the location and operation of dump sites. They are selected by the municipal authorities. The EIA procedure will alter this when it is introduced.

Under the new legislation, it is expected that monitoring of discharges to ground and surface water would be undertaken by the Ministry of Land Reclamation, Regional and Water Development (MLRRWD). It might, however, be delegated to the local authorities.

SPECIFIC SITUATIONS

Nakuru

Nakuru is a city of about 250,000 inhabitants, some 150 km north of Nairobi, in the rift valley. It relies extensively on dumping stations in the low income areas. The dump site is on the edge of the town. It has no staff or any control. The City is believed to be technically insolvent,

Machakos

This City, of about 100,000 inhabitants, showed no interest whatever in participating.

Limuru

This town, about 25 km North of Nairobi, has some 30,000 inhabitants and has a predominantly agricultural economy, although there is also a Bata shoe factory and a number of sawmills. The

Council appear to be interested in participating and the town was recommended by the Ministry of Environment.

The dump site is about 6 km outside the town in a forest, well away from housing. The waste volume appears very low - probably well below 10 tonnes/day (because of the poor collection service) - and contains a significant amount of dust, although there is also quite a bit of plastic.

Collection trips consist of 7 trips a week each by a tipper and tractor/trailer. The latter appears to have a payload of about 1.5 tonnes. If the tipper does 3 tonnes, this gives a total of about 30 tonnes a week.

There is also a Bata shoe factory which has its own incinerator. This is currently shut down by the council for making too much smoke. The plant was designed (?) And built by a local firm in Nairobi. It is of steel construction and has water scrubbing - to remove SO_x and NO_x. They are currently making some changes and hope to get it going again, as they are very short of landfill space. They have recently required operators to wear smoke masks. The plant is, however, situated in a valley which is subject to inversions. The waste from this plant has been analysed.

There are also several small sawmills, which have surplus sawdust.

GOVERNMENT ATTITUDES

Importance attached to waste management standards

MSW management is regarded as a major problem by the Ministry of Environmental Conservation. Whether it, or even the environment in general, is seen as a national priority, however, is more questionable.

What is clear, from the activities in Mombasa, is that there are votes in good MSW management.

PUBLIC PERCEPTIONS AND ATTITUDES

Level of concern about waste management

It appears that people are concerned by the inadequate management of MSW and the continuing decline in standards. In Nairobi, a survey showed that 36% of respondents thought that the problem of garbage collection was very serious and a further 22% saw the problem as moderate. If people are to be expected to pay for a service, however, the quality - particularly of collection - must be dramatically improved. It is unlikely that low income groups will be prepared to pay anything for such a service.

Level of concern about incineration

The Ministry of Environment showed some concern about the location of an incinerator and feared that the sight of a chimney near to housing might cause public opposition.

NGOs

The main environmental NGO is the Kenya Energy & Environment Organisation (KENGO). This NGO is active, mainly in the energy sector, but is also interested in waste management.

FINANCIAL ISSUES AND CONSTRAINTS

Arrangements for financing and recovering the costs of waste management

Nairobi City currently charges about Ks 20/household/month for waste collection and a similar amount is charged in Mombasa. The private sector charges ten times this amount or more - and yet a

significant proportion of households make use of the private sector. The Nairobi master plan provides for full cost recovery, but no attempt has yet been made to increase the charges - largely because it is expected that no one will pay unless the collection service quality is improved first.

Role of private sector

In Nairobi, there are three significant operators. These are Kenya Refuse Handlers (KRH), Domestic Refuse Disposal Services Limited (DRDSL) and Bins (Kenya) Limited. There are also about 30 smaller companies, which operate completely unregulated and are believed to dispose of much waste illegally.

A survey carried out in Nairobi¹ showed that 78% of respondents thought that privatisation would improve waste management services.

Attitudes to increasing expenditure on waste management

The municipalities are generally bankrupt. For example, in Nairobi, the Electricity supply company has ceased to supply the City, which has installed its own generator. In 1995/5 the City managed to collect 65% of the rates due - declining from 90% in 1991/2.

Mombasa, on the other hand, has made significant efforts, largely because of the importance of the tourist trade. Smaller towns seem to have a greater inclination to do something positive.

The Ministry states that municipalities will pay for better MSW management.

A survey¹ of residents of Nairobi has shown that 47% of those paying Ks 100/month or less would be prepared to pay more than Ks 200/month for good waste management services. 50% of those paying Ks 300-400 indicated a willingness to pay up to Ks 800/month.

COMMITMENT TO PROJECT

Central Government

The Ministry have declared an interest in the project (in writing), although they clearly recognise that it is not the answer to their MSW problems.

Local Government

Nakuru showed an interest, although the size, location and financial status of the City are far from ideal. Limuru also showed an interest, although the senior officials were not present.

POTENTIAL PARTNERS

The incinerator manufacturing company would seem to be an ideal partner.

LOW COST WASTE INCINERATOR COUNTRY REVIEW - MALAWI

REGIONAL CHARACTERISTICS

Demographic and socio-economic characteristics

Population :

GDP/capita:

Pay levels

Labourers <K1,000/month

Junior Managers say K2,000/month

Graduate Engineers K3,000/month

Unemployment

Climate

Annual rainfall (Lilongwe) is 800mm, mainly between November and March

Land use

There are relatively large areas of forest, although deforestation is seen as a major environmental problem. The land is very fertile and agriculture is the major industry. Finding space for landfills, however, would not appear to be a problem.

Water resources

Surface water provides the majority of supplies. There are problems of contamination due to inadequate sanitation and, to a lesser extent, solid waste management.

Industry

General

Malawi has a predominantly agricultural economy. There is a cement plant, however, which uses refractory bricks.

Engineering

There is some steel fabrication activity in Lilongwe. For example, skips are manufactured locally.

Bricks

Soft bricks are readily available.

Materials availability

Mild steel - angle, channel, tube, sheet, plate

Stainless steel

Electrical motors and switchgear

Refractory materials

These materials are all available, but would need to be imported from South Africa or Zimbabwe. Some steel stocks are held.

Manufacture of incinerators

None

Technical facilities

The University of Malawi has reasonable facilities

Air and water testing facilities

The Malawi Bureau of Standards possess analytical equipment suitable for air and water analysis, as do the university.

STATUS OF WASTE MANAGEMENT

Waste quantities

A study prepared by Sir Alexander Gibb and partners in 1992 estimated that some 15,000 m³ of MSW was delivered to the dump site. The population at that time was around 400,000, although now the population is nearer to 500,000.

At the present time, about 5 loads a day (7 day week) are collected using 12 m³ compactor vehicles, together with about 15 skips of 10 m³ capacity, which is estimated to amount to some 50 tonnes/day or about 17,500 tonnes p.a. This amounts to a generation rate of 0.1 kg/person/day. This is substantially lower than the figure of 0.5 kg frequently used, but it should be noted that there is very little evidence of any significant amounts of waste uncollected - unlike, e.g. Nairobi. Many people, however, use refuse pits on their own premises and, given the very low per capita income, this figure is believable.

Waste composition

An analysis will be carried out but, from examination, it would appear that some 75% or more of MSW collected consists of food and vegetable matter. With a returnable bottle system and limited use of beverage cans, the glass and metal content is low - especially after scavenging has taken place.

Impacts from waste-related pollution

The National Environmental Action Plan states that pollution of water resources is occurring from poor waste management standards but, in our opinion, this is mainly from poor sanitation rather than solid waste.

Formal or informal strategies and plans

A national Environmental Action Plan was prepared in 1994. This contains the following objectives for solid waste management:

- Ensure that household in areas not covered by a refuse collection service have rubbish pits

- Introduce the separation of different types of waste before disposal
- Improve solid waste collection services by e.g. introducing collection points in traditional housing areas
- Practice sanitary waste disposal methods at landfills
- Ensure that siting of landfills take account of hydrological and soil characteristics as well as proximity to human settlements

Existing waste management projects

A waste management strategy for Lilongwe was prepared by Sir Alexander Gibb and partners in 1992. This recommended the construction of an engineered landfill at a cost of over US\$2 million. SIDA is now funding the preparation of tender and specification documents for this project. Whether they will fund the const is not clear. In our opinion, such a project is wholly unsustainable.

JICA were supposed to be funding the development of a modern landfill and sewage treatment works for Lilongwe. The STW is now working (well) but little has happened on the landfill.

UNEP (Basel Convention) funded a study of clinical waste management by Graham Noble (RSA). The study is four months late and of poor quality.

A World Bank Loan has been negotiated to provide skip vehicles and skips for all local authorities, to improve MSW collection standards. It is understood that a project to finance the development of a composting system for Lilongwe will commence shortly.

Organisational arrangements for managing wastes

City and District Councils undertake responsibility for solid waste collection and disposal. There is no private sector activity.

Waste minimisation and recycling

There are no known recycling activities, although scavengers collect bottles and cans which they are alleged to sell in the markets.

Storage and collection

Higher income areas of cities use standard dustbins, which are collected weekly - at no charge. Lower income areas use informal containers, such as baskets and buckets. By law, every household should have a dustbin. Communal skips are also used in commercial (e.g. market) areas and it is intended to use them in low income housing areas as well, when more containers are provided.

In Lilongwe, it was suggested by the City Council that only 20% of waste is collected. This could explain the low waste generation but there is little or no evidence of piles of uncollected waste. Refuse pits in gardens are used extensively, which may help to explain the situation.

Lilongwe uses three 12m³ compactor vehicles and two skip vehicles with forty 10 m³ skips. Three more skip vehicles, and some more containers are being provided through a World Bank loan. The skip vehicles do an average of 6 loads a day and the compactors do 2 loads a day.

Industrial wastes are collected by the Council for a charge and are also transported by producers. Disposal in the latter case is free of charge (to minimise fly tipping).

Disposal methods

The municipal landfill in Blantyre is reasonably well managed, with plant used to compact and, to some extent, cover the waste.

In Lilongwe the dump site is located to the SW of the City. The Council expressed the view that they would like to have another facility to the North, to reduce transport costs. There is a refuse compactor and also a Caterpillar D7H bulldozer at the site. This equipment is was acquired using a World bank loan in 1995. It is not used, however, although no real explanation could be obtained as to the reasons for this. It is probably due to lack of operator training and maintenance.

The Lilongwe dump site is completely uncontrolled, although there are 6 staff on site - 2 “captains”, 2 “plant operators” and 2 labourers.

Leachate can be observed emerging from the site and no attempt is made to prevent it from running into the nearest stream.

Legislation and Enforcement

The Environmental Management Act received Presidential assent in August 1996. This Act introduces a requirement for EIAs on new development projects and provides powers to introduce regulations for: analysis and classification of waste, the determination of methods for safe disposal of waste, monitoring and control of disposal sites, licensing of all waste management processes and control of transboundary movements. Indeed, no one is permitted to handle waste other than domestic waste without a licence, although none have yet been issued. The supporting regulations have not been prepared. Waste and hazardous waste are defined, though not in a very precise manner. The necessary regulations have not yet been drafted. The Act incorporates the establishment of an environmental fund, although it does not currently have any money. Penalties are provided within the Act of up to about \$20,000.

Enforcement is theoretically undertaken by the Ministry of Forestry, Fisheries and Environmental Affairs but there are only two individuals actually involved in waste management - and that only part time. The local authorities also have enforcement powers under the Public Health Act, but there is no evidence of any action.

Environmental standards (e.g. discharge limits) are established by the Malawi Bureau of Standards.

GOVERNMENT ATTITUDES

Importance attached to waste management standards

The Deputy Director of the Environment Ministry showed great enthusiasm for the project, but it would appear that this was simply because of the immense poverty of the country.

The Director is an agriculturalist, who has little interest in waste management. Appointments at the Ministry of Health and the Water Resources Board were not kept, which shows a low level of interest by both organisations.

The Ministry of Local Government views solid waste management as a serious concern and showed enthusiasm for the project.

PUBLIC PERCEPTIONS AND ATTITUDES

Level of concern about waste management

Apparently, the citizens of Lilongwe are concerned that their city is not clean. Visual inspection, however, suggests that this is far from the case. The streets were well swept and there was very little evidence of litter or fly-tipping. This would seem to indicate that the public are concerned about the cleanliness of their surroundings. Whether they are prepared to pay for it is less likely.

Level of concern about incineration

There appear to be few concerns about incineration.

NGOs

There are 24 NGOs working in the environmental sector in Malawi but they are not very active in the field of waste management, especially for hazardous wastes, preferring to concentrate on deforestation and soil degradation, which are probably more significant for the country.

FINANCIAL ISSUES AND CONSTRAINTS

Arrangements for financing and recovering the costs of waste management

At the present time, there is no formal cost recovery for waste management by local authorities. A charge has been recently introduced for private sector companies, but this is currently (at about MK600 per skip) well below cost.

Role of private sector

There is no private sector activity in the Malawi waste management sector.

Attitudes to increasing expenditure on waste management

The financial situation in Malawi is so desperate, that almost any additional expenditure is not possible at the present time. It is worth mentioning that the cost of the majority of human resources at the Ministry of Environment are funded by donor assistance.

COMMITMENT TO PROJECT

Central Government

The Ministry of Environment showed great enthusiasm, although less real understanding, for the project. The Ministry of Local Government also showed a strong interest and undertook to help obtain commitment from local authorities.

Local Government

Local authorities have not had any elected councillors since 1994, which seems to lead to a lack of pressure to take much in the way of positive action. Blantyre is said to be more positive than Lilongwe, however. President Muluzi has promised local elections during his term of office, but delays in introducing the necessary legislation have prevented this from happening. Presidential elections will take place in May 1999 and the Ministry suggests that local elections may take place in July/August. There is, however, no guarantee that this will happen.

Clearly, the City of Lilongwe would like to have the incinerator, but their performance with the donor-funded landfill plant shows that they cannot be relied upon to take any positive action.

The Ministry of Local Government recommended Blantyre as the most progressive council, although the population, at 800,000 is too great. Zomba is a possibility, with a population of about 250,000.

POTENTIAL PARTNERS - Not applicable.

LOW COST WASTE INCINERATOR

COUNTRY REVIEW - ZIMBABWE

REGIONAL CHARACTERISTICS

Demographic and socio-economic characteristics

Population : 11 million

GDP/capita:

Pay levels

Labourers US\$ 70 per month

Junior Managers US\$ 235 per month

Graduate Engineers US\$ 473 per month

Unemployment

Climate

The rainfall around Harare is about 2500 mm. The dry season is between April and October.

Land use

Land is very fertile and in great demand for farming use. Political issues place even greater pressure on land availability for subsistence farming.

Water resources

Water supplies for major towns are from surface water. Boreholes are used in rural areas for farms etc.

Industry

General

Zimbabwe has a substantial industrial base, including steel, foundries, cement, chemicals and mining.

Engineering

There are a wide range of engineering businesses.

Bricks

Bricks are manufactured widely in Zimbabwe. Refractory materials are available, although not manufactured locally.

Materials availability

Mild steel - angle, channel, tube, sheet, plate

Stainless steel

Electrical motors and switchgear

Refractory materials

These materials are readily available.

Manufacture of incinerators

No local manufacturer has been identified, but there are companies supplying furnaces for foundries etc.

Technical facilities

Good facilities are available at the University of Zimbabwe

Air and water testing facilities

Facilities are available at the University and can be coordinated by the Department of Mechanical Engineering, which has expressed a particular interest in the project. They would prefer the sampling kits to brought from the UK, as they are cheaper.

STATUS OF WASTE MANAGEMENT

Waste quantities

A paper³ published recently indicates that per capita production of solid waste is in the region of 0.311 kg/day. This would appear to be reasonably consistent with estimates of waste production in some of the towns visited.

Waste composition

The following data on waste composition is available:

Material	Range - Zimbabwe¹	Range - Marondera⁴	Survey - Marondera⁵
Paper & board	10-27%	15-20%	38%
Glass & ceramics	4-15%	10-15%	<1%
Metals	4-12%		4%
Plastics	4-15%	5%	15%
Leather & rubber	5-8%	10-15%	
Textiles	4-12%	4-7%	
Food & vegetable	15-28%	20-25%	43%
Miscellaneous	10-20%	15-20%	

It should be noted, however, that in some low income areas of, for example, Harare, the proportion of food and vegetable may be as high as 57.5%. In the towns visited, however, this was not the case.

In fact, we were informed by the Ministry of Environment that all local authorities are supposed to be carrying out an analysis of MSW. None of the three visited had done so and the MLGNH was not

³ *An overview of Solid Waste Management in Selected Urban Areas in Zimbabwe*, Admos O Chimhowu, Division of Policy and Strategic Studies, Zimbabwe Institute of Public Administration and Management, 1998

⁴ *Zimbabwe Urban Solid Waste Management Study*, Tevera-Mubvani & Associates, August 1995

⁵ Survey carried out on behalf of the contractors –March 1999

aware of this.

Formal or informal strategies and plans

No strategy has yet been prepared.

Existing waste management projects

The World Bank/UNDP carried out a study in 1991. An Urban Solid Waste Management Study was prepared in August 1995². The World Bank operates a Project Coordination and Management unit (PCMU) for local authority projects

SIDA is developing a modern landfill at Gweru. The MLGNH was not aware of this but the PCMU is vaguely aware. SIDA say that this project is being done by a small firm of consultants and will shortly come to an end. The MMET said that they were working with all local authorities. This may have been the case in the past, but the project is clearly not very high profile. SIDA do not intend to do any more work in the area..

CIDA will be helping with the implementation of the proposed Environmental Management Act

Organisational arrangements for managing wastes

Local authorities have a responsibility to collect and dispose of MSW in their area and, under the proposed Environmental Management Act, will have a responsibility for controlling and preventing pollution as well.

A visit was made to the Blair Institute, the research arm of the Ministry of Health. Urban sanitation is now the main interest of the Institute. Waste supply and sanitation is also a major focus for several ministries and, as a result, a National Action Committee (NAC) has been set up to coordinate the activities in several Ministries and other stakeholders. Some of these are:

- Ministry of Local Government and National Housing
- Ministry of Health
- District Development Fund (part of MLG)
- Ministry of Water resources
- Ministry of land and Agriculture
- Ministry of Mines, Environment and Tourism
- National Economic Planning Commission (under President's Office)
- Ministry of National Affairs and Employment Creation
- Environment 2000
- UNICEF
- Christian Care

The NAC coordinates projects, donor inputs and relevant research.

Waste minimisation and recycling

Collect-a-can operate in Zimbabwe for the recycling of beverage cans. Most bottles are returnable, so few find their way into MSW. Cardboard is collected for recycling, together with some paper.

Storage and collection

In the towns visited, the quality of collection was variable. In some it was excellent, whilst in others,

particularly those without councillors (see below), the quality was lower. The system used in all the towns visited was kerbside collection - on a 7 day week basis. There was some evidence of plastic 240 litre Eurobins, but no vehicles were equipped to lift them.

Disposal methods

At all the towns visited, disposal was by crude dumping. Every town was aware that this required improvement and all were enthusiastic about the possibility of incineration. Harare has particular problems, which are quite high profile. A major dump site was closed recently because it was burning and medium density housing had been developed close to it.

Harare has a 20 year old incinerator, but it has been closed for some time now.

Legislation and Enforcement

At the present time, the only relevant legislation are the Public Health Act and the Local Government Act. These laws give no powers to the Ministry of Mines Environment and Tourism.

A draft of an Environmental Management Act, however, is currently undergoing consultation and will shortly be finalised. This will introduce the licensing of waste disposal facilities, although there is currently no provision for the registration or licensing of transporters or of recycling or treatment facilities. Permits will also be required for emissions to air and water and EIAs will be required for waste management facilities.

Regulations will be required to give effect to these features, so it may be expected that some time will pass before licensing comes into effect.

SPECIFIC SITUATIONS

The Ministry of Local Government recommended visits to three towns of appropriate size, all of which has expressed interest in the project.

Marondera Municipal Council

The population of Marondera is 53-55,000. The Senior Environmental Health Officer, Peter Magundani, has recently completed an environmental health MSc at Dundee and is a member of the Institute of Waste Management, having a good understanding of the subject. He is very enthusiastic about the prospect of an incinerator and gave an assurance that he would make labour available to operate it.

The town is very clean, with no evidence of litter or fly-tipping. Water supply comes exclusively from surface water, making use of 3 or 4 dams. Collection is carried out using one (new) 12 m; compactor, one 7 m; open top tipper (similar to that used in Kanye, Botswana) and one 3.5 m; (approximately) tractor and trailer. Each vehicle is claimed to do 3 loads a day (7 days/week). Assuming payloads of 2.5, 1.0 and 0.5 tonnes respectively, this would give 12 tonnes a day. Top estimate is 15 tonnes.

Waste is dumped at an old gravel pit, which is occasionally tidied up with a tractor shovel.

The waste composition appears very suitable for incineration, with low proportions of food waste, cans and bottles. The reasons for this are that the Council encourages householders to compost food wastes, and cans and bottles are recycled or returnable. A scavenger used to pick paper (or cardboard?) from the site and claimed to collect 10 tonnes a month. It is not clear why this activity ceased. The hospital/clinic has an incinerator, so there is no untreated clinical waste being dumped.

In addition to the household waste, there is a significant quantity of leather trimmings from a leather

works. There is also a small tyre retreading plant on the industrial estate, which could provide further high CV material.

Marondera is a growing town with a significant industrial estate, which houses a major abattoir/cold store, a brickworks and a very large hardware store. This area is located well away from existing housing and none is planned. The land is in the ownership of the Council and would make an ideal location for an incinerator.

Rusape Town Council

Rusape is a smaller town of 22,000 population. It is under the supervision of a Commissioner from the Ministry of Local Government, because the elected council was dismissed for corruption. The Town Engineer has been appointed Acting Town Secretary.

Collection is inefficient, making use of tractors with 2.5 m³ trailers, holding an estimated 0.3 tonnes. These are alleged to do 3 - 4 trips a day, which would give about 3 tonnes a day. The dump site, which is unsupervised, was flooded due to the wet weather and is apparently like this for some 3 months of the year. The water was black. The quantity of waste deposited recently indicated that the waste quantity estimated above may be on the high side - no doubt because of collection inefficiencies.

As a Town Council, Rusape does not have an Environment Health Department and this function is performed by the Ministry on its behalf. Waste management is the responsibility of the Town Engineer.

Bindura Municipal Council

Bindura, with a population of rather more than 30,000, has recently achieved Municipal Council status, which has greater responsibilities (including development planning) than a Town Council and an executive mayor. Unfortunately, like Rusape, the entire Council resigned - no doubt for similar reasons - and the Town is under the supervision of a Commissioner. Again the Town Engineer is the Acting Town Clerk. Elections are planned for April.

Bindura is heavily dependent on gold (Ashanti) mining and nickel (Anglo American) mining/smelting. There is little other industry.

The town uses four tractors and 3.5 m³ trailers, doing about 3 loads a day, giving about 6 tonnes a day of waste. The town supplies dustbins for the kerbside collection system but these are mainly cut down oil drums and are in a very poor state of repair, many without bottoms. The dump site consists of two former opencast mine excavations. A tractor shovel was observed working on the site, but this is apparently an occasional activity. It was burying untreated clinical waste.

GOVERNMENT ATTITUDES

Importance attached to waste management standards

This is clearly an issue which the Government wishes to address.

PUBLIC PERCEPTIONS AND ATTITUDES

Level of concern about waste management

Waste management is a significant concern for the public, who regularly criticise their Councils for

the quality of service.

Level of concern about incineration

There is little evidence that there would be opposition to incineration.

NGOs

The main NGO concerned with waste management in Environment 2000. They appear to be quite interested and positive about the project.

FINANCIAL ISSUES AND CONSTRAINTS

Arrangements for financing and recovering the costs of waste management

In the smaller towns, such as Rusape and Bindura, no charge is made for MSW collection and disposal, no doubt because of the poor service quality. In Marondera, however, the full cost of service provision is recovered by means of a monthly charge of \$33 for households and a charge of \$45 per container for industrial waste.

Role of private sector

There is currently no private sector activity, with the single exception of a liquid waste contractor in Harare (Pixley waste removals), which appears to use non-vacuum tankers.

Attitudes to increasing expenditure on waste management

We are informed by the MLGNH that expenditure in the region of Z\$1 million would present no problem to Municipalities, who regularly invest sums appreciably larger than this.

COMMITMENT TO PROJECT

Central Government

The Ministry of Local Government and National Housing (MLGNH) expressed enthusiasm for the project. The Ministry of Mines, Environment and Tourism expressed also showed a positive interest, although they clearly did not see that they had a prime responsibility for solid waste management.

Local Government

Local government showed great enthusiasm for the project and, in the case of Marondera, can give some confidence that the project would be sustainable. The MLGNH informed us that the most progressive Council of all is Kariba. Unfortunately they were not available to meet us.

POTENTIAL PARTNERS

It has been suggested that the most suitable partners will be companies involved in the supply of combustion equipment to the foundry industry.

RECOMMENDED MUNICIPAL PARTNER

It is recommended that if the pilot plant is constructed in Zimbabwe, the partner municipality should be Marondera.

LOW COST WASTE INCINERATOR COUNTRY REVIEW – THE GAMBIA

9.1.1. WASTE QUANTITIES

Initial estimates for Kinafing Municipal council are 298 tonnes per day (council records) and for Banjul, 30 – 40 tonnes per day. Both these are larger than the anticipated quantities for the prototype incinerator but a number of possibilities exist.

In Kinafing collection is broken down into zones. The prototype Incinerator could be designed to dispose of waste from a single zone. If the technology proves to be appropriate then these could be replicated in other areas of the municipality. This would reduce the environmental impact on any one site.

Some pre-sorting of waste is anticipated to remove recyclables and perhaps compostables. The remaining waste in a single zone or indeed in BCC may well then fall within the anticipated range.

9.1.2. WASTE COMPOSITION

We recommend that a simple waste analysis exercise be carried out by local consultants to give a clearer picture of the composition of Municipal Solid Waste and to determine whether incineration is an appropriate component in an overall waste disposal strategy. Initial evidence from Kinafing however seems to suggest that the waste does contain a significant combustible fraction, enough to sustain prolonged burning after spontaneous outbreak of fire.

A larger waste analysis exercise is to be carried out by NEA (funded by World Bank). This will also provide valuable information which will help in determining the most appropriate combination of waste disposal techniques.

9.1.3. FORMAL OR INFORMAL STRATEGIES AND PLANS

NEA is in possession of a Solid Waste Disposal Strategy which was a result of a study carried out in 1995 by Mouchel with funding from World Bank. This strategy is due to be reviewed in May. A major constraint to implementing certain aspects of the plan has been the absence of accurate waste composition data. Now that funding for this study has become available (World Bank), the data collected should allow the implementation of this plan to move forward.

It is clear that NEA is considering many possible components for waste handling including the use of recycling and composting programmes.

9.1.4. ORGANISATIONAL ARRANGEMENTS FOR MANAGING WASTE

In the Gambia all waste management is currently the responsibility of local authorities. Historically the Department of Public Health was responsible for waste collection and disposal. In the Greater Banjul area, this was followed by a period where the service was contracted out to a private company. Following deterioration in the level of service, responsibility was handed over to the local authorities – Banjul City Council and Kinafing Municipal Council.

9.1.5. WASTE MINIMISATION AND RECYCLING

Waste minimisation and recycling are important components of the evolving waste management strategy for the Gambia. Currently the recycling of aluminium and plastic is

taking place at an informal level only, this is possibly due to restricted access to economically viable markets and the general lack of awareness of the potential value of certain recycled waste. NEA are actively encouraging schemes by NGO's such as US Peace Corps to reuse and recycle waste as part of income generating activities for local communities and women's groups. Minimisation, recycling and composting are seen as central parts of future waste management development.

9.1.6. *STORAGE AND COLLECTION*

Household waste is generally stored in or near the household until collection day. In KMC this is scheduled to take place once per week although some areas do not receive a collection service for up to three weeks or more. In certain parts of Kinafing residents make use of unauthorised dumps which are periodically cleared by the cleansing department.

9.1.7. *DISPOSAL METHODS*

All waste is currently disposed of in crude landfills. Waste is deposited, levelled and then covered with a layer of sand. Open and uncontrolled burning is a common problem on such sites.

9.1.8. *LEGISLATION AND ENFORCEMENT*

Currently Municipal Councils make use of certain parts of the Public Health Act. This however does not afford them adequate powers and as a result there are very few instances that have led to prosecution of those who are instigating public health hazards through handling and dumping of waste. There are at present no appropriate municipal byelaws and no waste management legislation. A study has been carried out recently however in to all existing legislation which touches on environmental issues, and incompatibilities between individual pieces of legislation have been identified. NEA is keen to press ahead with the preparation of draft legislation that it hopes will give adequate powers to local authorities to deal with waste management issues.

Much concern has been raised by NEA and local councils about the vast increase in the quantity of LDPE waste resulting from the use of plastic bags. This waste is noticeable almost everywhere in the Greater Banjul area and is all the more problematic as it is easily borne by wind. There have been suggestions to government about the possibility of taxing the importers of this commodity to try and instil responsibility for the environmental impact at source. An licensing application by a manufacturer to produce the bags locally has also met with opposition.

9.1.9. *SPECIFIC SITUATIONS*

9.1.10. Kinafing

KMC cleansing department has reasonable waste collection facilities, which includes a fleet of trucks and trailers. It has made valiant efforts to collect and dispose of waste in the municipality, however difficulty in raising adequate revenue from local residents has meant that collection vehicles are poorly maintained and currently a large number are non-operational.

KMC currently disposes of its municipal waste at a land fill site in Bakoteh. The site is unfenced and is subject to frequent outbreak of uncontrolled fire due to spontaneous combustion and deliberate incineration of cable waste by scavengers. The site is situated within a heavily populated area and the fact that it is unfenced means that it is used as a thoroughfare by local residents and schoolchildren. Council supervisors are aware of the problems at the site and realise that it presents a potential health risk to local residents.

The volume of waste disposed of at the site each day is around 298 tonnes (according to council record sheets) which would suggest that this is much larger than the anticipated capacity of the incinerator. However the position of the site within such close proximity to an area of high population density suggest that the incinerator would be best sited elsewhere. A plot within the industrial area has been suggested as a potential site for a pilot plant. Permission to use the land must be sought from the relevant government office, however the chairman and town clerk of KMC see no particular obstacle to acquiring a site there.

9.1.11. Banjul

Banjul City Council (BCC) has the responsibility of dealing with waste from within the boundaries of Banjul city itself. The physical location of the city on an island surrounded by mangrove has meant that its growth and expansion has been restricted. Equally this has led to constraints on acquiring adequate land for land fill sites. A recent study using GIS information carried out by NEA failed to identify any suitable site within practical distance from the city. The pressure to for waste amelioration here is therefore great.

BCC claim to collect virtually all of the waste generated from within the city (compared with 40% by KMC) which is disposed of using crude landfill at the * site. The composition of waste here is likely to be different to that of KMC as Banjul is the administration and business centre.

9.1.12. *GOVERNMENT ATTITUDES*

The government in Gambia is clearly concerned about waste management and environmental issues and representatives from both the Ministry of State (responsible for NEA) and the Ministry of Local Government have indicated that they will back any initiative that will help to improve what is seen as a growing problem. Within the National Environment Agency itself there is a clear awareness of the need to implement a National Waste Management Strategy which is balanced and appropriate to the needs of the country. The most pressing problem is seen as being in the Greater Banjul area and the nearby rapid growth areas. Officers within the NEA are very well informed about waste management issues and are committed to working with the relevant bodies both public and private to ensure an appropriate strategy is put into place.

9.1.13. *PUBLIC PERCEPTIONS AND ATTITUDES*

9.1.14. Level of concern about waste management

Reports from NEA and Local Councils suggest that there is a growing public awareness about waste management issues although this tends to manifest itself when residents fail to receive the services they expect from their local councils. There is also some evidence that certain householders are willing to pay for an improved service. Sensitisation through public education programmes and the use of the media is seen as being one way of raising public awareness about this important issue.

9.1.15. Level of concern about incineration

There is little evidence that there would be opposition to incineration as long as reasonable performance in terms of emissions is maintained. The NEA in its role as regulating body is keen to ensure that any plant meets its own standards as regards EI. However there is an appreciation that the “do nothing” option where waste is allowed to burn open and uncontrolled currently results in potentially hazardous levels of environmental pollution.

9.1.16. *NGOs*

A visit to TANGO, the independent umbrella group for NGOs in Gambia revealed the existence of 53 registered NGOs. The majorities of these are active in the areas of Agriculture, Natural resources and Health and concentrate their work with rural communities. Those NGOs with an urban focus tend to be active in the area of skills training and business support. There were no particular NGOs that were identified as having a direct interest in the issues surrounding the project. It is decided however that a close relationship with TANGO would help to keep the NGO community informed about the project and would help sensitise them to the issues involved.

9.1.17. *FINANCIAL ISSUES AND CONSTRAINTS*

9.1.18. Arrangements for financing and recovering the costs of waste management

Both local authorities (KMC and BCC) stated that they had difficulties in raising adequate resources through rates to pay for the level of waste management service that residents expected of them. Both councils however did operate a tariff scheme that was applied to

- households who were in possession of a wheelie bin,
- restaurants
- hotels
- residents who requested disposal of non-standard waste

Suggestions from NEA for a scheme whereby customers are charged for disposal of waste in direct relation to the volume they produce has been considered by the Department for local Government. The situation though is not straightforward and Local Authorities are understandably reluctant to implement measures that might discourage residents from using the LA waste disposal facility. There is a perceived danger that residents will instead choose to dispose of waste themselves through uncontrolled burning or dumping rather than pay a charge for LA disposal.

The Permanent Secretary for the Department of Local Government did state however that one of the goals of his department was to increase the level of efficiency of local authorities in general thereby freeing up extra revenue for cleansing services. He stated that in the last financial year he had authorised increases in the annual budgets to both councils for cleansing as a result of the importance he attached to this area of local authority responsibility.

9.1.19. *ROLE OF PRIVATE SECTOR*

At present all waste management and cleansing services are provided by local authorities. In 1995 cleansing and waste management in the whole of the greater Banjul area was handed over from the department of public Health to a private contractor. The initiative was deemed to have been a failure after the level of service declined substantially and responsibility for these services was eventually handed to local authorities. The experience has led many to be wary of the privatisation of these services. However both local authorities and the Ministry of Local government admit that Municipal councils do not have the resources to manage these services efficiently. There is a growing realisation amongst all players that privatisation, provided that it is handled carefully and transparently, could lead to a more efficient and cost efficient service. Suggestions such as awarding contracts on a zone to zone basis rather than on a municipal level and relating payment to performance levels are currently being considered.

9.1.20. *ATTITUDES TO INCREASING EXPENDITURE ON WASTE MANAGEMENT*

Statements from the permanent Secretary for Local Government suggest that his department is committed to increasing expenditure in this area providing that local authorities can improve their level of efficiency and reduce the sometimes disproportionate level of administrative overheads that they incur.

9.1.21. *COMMITMENT TO PROJECT*

9.1.22. Central Government

Discussions during meetings with the Permanent Secretary for the Department of State (responsible for the NEA) and the Permanent Secretary for the Department of Local Government show that the Gambian Government are clearly committed to the project provided that it can be shown to be of benefit to the people of Gambia.

9.1.23. National Environment Agency

As a result of meetings and discussions, the NEA are also clearly committed to the project and see it as a potentially important component of their own programme. It must however be demonstrated that low cost incineration is an appropriate component of the Gambia's National Waste Strategy.

9.1.24. *LOCAL GOVERNMENT*

Both Local Authorities visited were very keen to collaborate with the project again provided that it could be demonstrated to be an appropriate solution to some of their current waste management problems.

9.1.25. *POTENTIAL PARTNERS*

A number of potential partners were identified during the visit. These were;

9.1.26. National Environment Agency

NEA can operate as a co-ordinating agency as well as advising on environmental aspects of the project. The EIA department is well placed to assist in the implementation of EIA studies. They are currently undertaking a number of air quality studies in the Greater Banjul area.

9.1.27. Municipal Councils

Both councils are potential partners who could host the building and operation of the pilot plant.

9.1.28. Gambia Technical Training Institute

The GTTI is the primary institution for technical education and vocational training in the Gambia. They are well placed to contribute to the in-country testing and performance measuring phase of the incinerator test rig should this be carried out in the Gambia.

9.1.29. Department for Community Development

DCD is a government department that is involved in the development and dissemination of appropriate technologies targeted at rural poor. Their experience with appropriate technologies means that they could provide valuable contribution at the design and development stage.

9.1.30. Gambia Association of Construction, Contractors and Consultants

GACCC act as an umbrella group for the many professionals whose services could potentially be used in the construction and commissioning of the pilot plant.

9.1.31. GCCI

The Gambia Chamber of Commerce and industry are the primary body for representing to foreign investors and to government, the interests and concerns of commercial businesses operating within the country. They are well placed to liaise with government on the privatisation of local authority services and could provide valuable input on the potential for disseminating small scale incinerator technology to the private sector for replication within Gambia and the sub region.

9.1.32. GAMWORKS

GAMWORKS is a public works agency who could potentially play an important role in the construction of the pilot plant. They are funded by the World Bank and have within their programme a component for building the capacity of local councils with regard to waste handling and public sanitation.

9.1.33. TANGO

The association can provide a valuable link to the NGO community who may represent or have access to important stakeholders in the project.

9.1.34. Local Consultants

Local consultants have been identified to carry out initial waste analysis surveys and to provide background information of the socio-economic profile of the region.

9.1.35. *CONCLUSIONS AND RECOMMENDATIONS*

Further information is needed to determine the precise nature of the waste streams in the greater Banjul area. Once this has become known then the appropriateness of small scale incineration and its place within an overall waste disposal strategy will become more apparent. Initial evidence would seem to suggest that successful incineration of waste is certainly possible within the dry season.

Incineration of waste within the outskirts of the City of Banjul itself would seem to provide one solution to the increasing problem of access to land for landfill use. The proximity of the site the city itself must be taken into consideration when deciding whether or not to site a pilot plant in this area.

In terms of potential commitment to the project, all stakeholders showed a keen interest in collaboration and a firm commitment to waste disposal issues in general.

There are in existence in the Gambia, a wide range of potential partners who could provide valuable inputs which would help to ensure the success of the project.