COMPOST MARKET ASSESSMENT
FREETOWN, SIERRA LEONE

MAY 2013

GOAL an international humanitarian organisation

Oxfam

UKaid from the British people

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List of Acronyms

BEO	-	Block Extension Officer (Ministry of Agriculture)
EHD	-	Environmental Health Department, Ministry of Health and Sanitation
EPA	-	Environmental Protection Agency
FAO	-	United Nations Food and Agriculture Organization
FBO	-	Farmer's Based Organization
FCC	-	Freetown City Council
FSM	-	Fecal Sludge Management
JICA	-	Japanese International Cooperation Agency
SLARI	-	Sierra Leone Agricultural Research Institute
SOIL	-	Sustainable Organic Integrated Livelihoods
UPA	-	Urban and Peri-Urban Agriculture
WASH	-	Water, Sanitation, and Hygiene Promotion

Exchange Rates (May 2013)

1 USD	=	4300 Leones
1 Euro	=	5600 Leones
1 British Pound	=	6550 Leones

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Executive Summary

A basic market survey for compost made from human fecal sludge was conducted during the months of April and May, 2013, in Freetown, Sierra Leone. This survey compiled information on available soil amendments as well as potential customer groups with the aim of estimating potential demand for fecal sludge compost. Customer acceptance of fecal sludge re-use along with perceived ability and willingness to pay were also assessed. A review of GOAL's pilot co-composting facility was also conducted and recommendations were provided regarding the structures in place as well as all operational plans. Finally, available organic solid wastes (OSW) were identified as potential co-composting material for the pilot facility.

Imported chemical fertilizers, mined landfill soil (bome), chicken manure, palm kernel cake, compost, pig manure, and cow manure are all available in Freetown in varying quantities. While there was a perceived high demand for the imported chemical fertilizer, the high costs reportedly force customers (UPA and provincial farmers), to purchase based on cash flow as opposed to actual need. Palm kernel cake (PKC) and landfill soil (bome) were both in the greatest supply of the remaining amendments, but actual sales were found to be hard to independently verify. Reported sales of PKC are as high as 1,200 50kg bags per month, while bome is more sporadic and can have sales of up to 60m^3 and then nothing for a number of weeks. Chicken manure was perceived as the most valuable and expensive organic amendment, a 50kg rice bag selling for between Le. 35,000 and 40,000. Supply, however, is limited, and poultry farms are unable to meet the demand.

Customer groups selected for the survey, based on stakeholder meetings as well as literature reviews of other similar projects, included the following: urban and peri-urban (UPA) farmers, large agricultural companies, landscapers, florists, golf clubs, hotels, real estate companies, construction companies, and mining companies. Participants from these groups had an overwhelmingly positive perception of compost made from human fecal sludge, with many recognizing its potential nutrient value and similarities to other animal manures. Very limited concerns were brought up regarding potential health risks, with much of the attention directed towards the compost's potential costs and its effect on yields. Knowledge around the benefits and use of compost varied widely between groups as well as within groups, with some confusing compost with manure and chemical fertilizers while others concerned with the specific properties of the compost.

This survey revealed a strong perceived demand for compost by numerous groups, as there are very few soil amendments available in quantities, at affordable prices, and of good quality. Mining companies and large agricultural companies represent the groups that would need the highest volume of compost, and who are using primarily chemical fertilizers and low amounts of animal manure. Others interviewed, like formal landscapers, expressed frustration with the poor quality of

the landfill soil but used it anyway due to the lack of other choices. Some, like UPA farmers and one of the large agricultural companies, recognize the negative long-term effects of chemical fertilizers and are looking for organic alternatives and/or supplements.

Based on the information collected during this survey, the most attractive customer groups to target as potential compost customers are formal landscapers, large agriculture companies, mining companies, golf clubs, and high-end florists. With the exception of the high-end florists, the other groups were perceived to have a medium to high potential demand as well as ability to pay. The high-end florists are included as they showed a very good understanding of compost and would be able to therefore provide very valuable feedback. The golf club did not display a good understanding of compost but the proximity and high demand make it an attractive customer group.

Introduction of the compost to any potential customer groups should be done in a low-risk, controlled manner so that any changes/improvements can be made to the product and presentation before opening it up to the larger public. By identifying one or two representatives from each of the suggested customer groups, compost samples can be provided free of cost in return for valuable feedback regarding the product. These "early adopters" can help GOAL refine product quality, proper application, presentation, and pricing before offering the compost for sale to the general public. This approach would also test the perceived demand for each customer group and better inform who to specifically target once there is sufficient supply of compost.

Prior to any distribution or sale of compost, however, the safety and quality of the compost must be ensured. This should be done via regular temperature monitoring of the compost piles as well as soil tests for indicator pathogens. The 2006 WHO guidelines offer both an ideal standard for pathogen levels for agricultural re-use of excreta as well as suggestions on adapting a progressive implementation of these standards.

Key Market Survey Recommendations:

1. Ensure safety of the final product through regular temperature monitoring and periodic pathogen testing
2. Implement an "early adopter" approach to introducing the compost, providing free samples to compost-savvy representatives of targeted customer groups in return for feedback on quality, marketing, and pricing.
3. The following customer groups and suggested representatives should be targeted as early adopters:
    - Formal landscapers : Eskarnn Flowers and Landscape Design
    - Large-scale Agriculture Companies: Bengal Agro SL Ltd.
    - Mining Companies: Sierra Rutile
    - Golf Club: Freetown Golf Club
    - High-End Florists: Awuna Florists

4. Introduce a price for the compost based on the feedback from early adopters, starting low (in range of bome and PKC) and
5. Maintain regular communication regarding progress with relevant ministries (Agriculture, Health and Sanitation) so as to garner support for the project and facilitate any issues that may come up as the pilot progresses.

Key Co-Composting Recommendations:

1. Conduct small pilots with the different organic solid wastes identified that will ensure proper composting as well as a quality final product.
2. Numerous modifications to the compost structure and drying bed are needed before a pilot can commence (see Annex II).
3. Necessary hygiene infrastructure must be installed and protocols be developed to reduce any potential public health risk at the pilot facility.
4. Collaboration with Freetown City Council should be formalized in order to build capacity for future monitoring and oversight while also navigating the requirements of the relevant ministries for the pilot phase.

1. Introduction

Background

Despite steady rates of urbanization and a population estimated at around 1.5 million people, Freetown currently lacks any functioning waste treatment facility. Two drying beds, constructed in 1994 at the Kingtom landfill site, currently receive low amounts of liquid waste during the dry season but these ceased functioning properly long ago and contaminated leachate flows into the nearby lagoon as well as the neighboring community (Gogra A.B., 2010). Hope for improvement both to waste collection as well as waste treatment came in the fall of 2012 when the Government of Sierra Leone signed an agreement with Masada Energy International – SL to become responsible nationwide for collecting, managing, and converting the liquid and solid waste into reusable ethanol. With intentions to start first in Freetown, project delays and controversy around contract terms and existing assets has mired Masada and remains to be seen what impact they will have on the sanitation and waste treatment sectors.

In this context, GOAL has been exploring alternative options for safe waste treatment. Although past interventions have focused on household-level sanitation interventions, GOAL's WASH program has recently embarked on a pilot co-composting facility, designed to effectively treat human waste while also producing a safe, re-usable compost. This compost would not only return valuable nutrients back into the environment in a safe manner but also potentially generate income through sales, lowering the costs of the waste treatment operation.

This model of recovering and reusing nutrients stored in human wastes on a larger scale has gained more attention in recent years. The International Waste Management Institute, based in Ghana, is currently analyzing over 50 different potentially successful business models from around the world that are linking waste recovery with reuse in agriculture, horticulture, energy production, as well as other sectors (IWMI, 2013). Recognizing and reusing nutrients found in human waste is not limited to developing countries however, with countries like the United States applying up to 50% of total biosolids produced nationwide back onto farmland (EPA, 2012). The positive effects biosolids have on turf establishment have been well researched, which has lead to its use in landscaping and golf courses (Schnell R.W., 2009) (Loschinkohl C., 2001).

Safety and Fecal Sludge Compost

Human feces contain varying levels and types of pathogens depending on the local conditions, and when not managed properly can pose serious health risks to a community. Ensuring high pathogen die-off is therefore of primary concern for a waste treatment facility. While there are a number of ways of eliminating pathogens, thermophilic composting achieves high die-off by reaching and sustaining high

temperatures that kill even the most resistant pathogens (*Ascaris lumbricoides*). While standards vary slightly by country and agency, the WHO international guidelines call for sustained temperatures of 50°C for a minimum of one week to achieve necessary die-off (WHO, 2006). The levels of pathogens acceptable for agricultural re-use is less than 1 viable *Ascaris* ova, and less than 1,000 *E. coli* colonies, per gram of total solids (WHO, 2006) .

The 2006 WHO guidelines also acknowledged that the mentioned limits are potentially impractical for developing countries who want to capitalize on the benefits of compost but do not have the capacity or the resources to do so. In these situations, the WHO guidelines recommend designing regulations according to a risk-management plan, specific to the local context, and progress towards implementation of the above-mentioned standards. To achieve this, quantitative microbial risk assessments can be used to identify acceptable pathogen levels where as to not significantly increase the risk of infection beyond the current local endemic rates. This type of undertaking should be done in coordination and/or with the approval of the local Ministry of Health and Sanitation.

Quality of Compost

The qualities of compost vary depending on a number of different components, some of which are provided in table 1 below.

Table 1. Compost Quality Components

Compost Quality Components	
•pH	•nutrient content (NPK)
•salinity	•density
•H_20-retention capacity	•% moisture content
•particle size	•particle size
•% organic matter	•stability

Specific values for each component are not included as they may vary depending on customer and intended use. In addition, the quality of the soil where the compost will be used will change the *ideal* values of the different parameters, while the amounts of different ingredients to the compost will also have a large effect on the possible values. Producing a consistent product of high quality is an important factor in attracting and keeping customers. Achieving this thereby requires careful monitoring as well as control by those producing the compost.

Benefits of Compost

Compost is a mix of decomposed organic matter that has the ability to improve a soil's physical, chemical, and biological characteristics. Although a common perception is that compost's value is a result of the nutrients that it contains, there are a number of qualities, found in Table 2, that make it a valuable soil amendment.

Table 2. Compost Benefits

Benefits of Using Compost
1. Improves the soil structure, porosity, and density, creating healthy root environments
2. Increases infiltration & permeability of heavy soils, reducing erosion and runoff
3. Improves water holding capacity, reducing water loss and leaching in sandy soils
4. Supplies a variety of macro and micronutrients
5. May control or suppress certain soil-borne plant pathogens
6. Supplies significant quantities of organic matter
7. Improves cation exchange capacity of soils improving nutrient holding ability for plant use
8. Supplies beneficial microorganisms to soils and growing media
9. Improves and stabilizes soil pH
10. Can bind and degrade specific pollutants
(The US Composting Council, 2001)

2. Objectives

This market survey was carried out to explore the potential demand for compost made from fecal sludge in Freetown and the Western Area of Sierra Leone. The results of this market survey and the accompanying recommendations will serve as a tool for GOAL when they begin to produce significant quantities of compost whose value is known and has been proven to be safe.

The specific objectives of the market survey were the following:

- Identify and characterize all of the competing soil amendment products and the suppliers in the Western Area.
- Identify and characterize the different customer groups using soil amendment products and their practices.
- Identify all customer groups who are not currently using soil amendments but might potentially purchase compost. Determine the market needs of these groups including the specific characteristics that they would require.
- Assess the customer knowledge of compost and their attitudes towards using compost as a soil amendment. In particular, evaluate the socio-cultural and religious acceptability of using compost produced from faecal sludge.
- Determine customer's willingness/ability to pay for compost, quantities per unit area (as well as seasonal demand) and frequency of application. Where possible, estimate total volumes of compost demand in the Western Area by applying estimated quantities required to land use categories.
- Identify the triggers for customers to purchase compost (focused on bulk purchasing and not household or subsistence farming level)

3. Methodology

3.1 Survey Team

The market survey was carried out in large part by one international consultant over a period of 6 weeks in Freetown. Language assistance was provided by NGO staff GOAL in situations where accurate data collection would have been limited. One enumerator was hired by the consultant for farmer focus groups and interviews, assisting with language and providing much-needed clarification and context to discussions around local agriculture practices.

3.2 Key Stakeholder Meetings

The market survey methodology, developed by the international consultant was finalized only after meetings with the following key stakeholders: GOAL, Oxfam, Freetown WASH Consortium, Adam Smith International, and Freetown City Council.

3.3 Data Gathering Methods

Data was collected in large part from primary data sources, including key informant interviews, site visits, and focus group discussions accompanied by entry surveys. When possible, data gathered from primary sources was verified through triangulation of responses collected from other sources. Secondary data sources were used to provide context for data gathered from primary sources.

Survey tools for UPA farmers were developed and approved by both GOAL and Ministry of Agricultural representatives before using in the field (Annex VI). While every attempt was made to contact key informants via email or phone for meetings, this proved to be difficult and time-consuming and unannounced visits (along with follow-up visits) proved to be the most successful.

3.3.1. Qualitative Data

Key Informant Interviews

Key informant interviews were conducted over a six-week period and made up a significant portion of the survey. While the completed informant interviews are provided in a categorized format below in table 3, in reality key informants often provided information on a variety of the stated objectives for the survey (soil amendments, potential customer groups, barriers, etc.).

Table 3. Main Key Informants

Soil Amendment Suppliers	Customer Groups
•4 people from 5 ID'ed poultry farms	•7 landscaping business owners
•2 compost suppliers	•7 owners of floral businesses*
•4 individuals at 2 bome landfill sites	•2 construction company owners
•1 Cabalah cowyard representative	•3 owners of architectural/design firms
•5 fertilizer suppliers	•3 managers and 4 gardeners at 4 hotels
•1 wholesaler owner	•1 manager and 2 gardeners at 1 real-estate co.
•2 large retailer owners	•1 director of Bengal Agro SL Ltd.
•1 small retailer owner	•1 representative of Magbass Sugar company
•2 informal merchant/traders	•3 representatives of the Ministry of Agriculture
•1 Manager at Marika Palm Kernel	•2 Block Extension Officers (Ministry of Agriculture)
•1 Min. of Agriculture stock controller	•2 representatives at London Mining & African Minerals^
	•1 Environmental Officer at Sierra Rutile
	•2 Block Extension Officers (Min. of Agriculture)
	•1 gardener, 2 management reps. at Freetown Golf Club
*6 of the florists were also landscapers, ^Extensive delays have occurred in procuring specific data	

In addition to those included in the above table, a number of other key informants provided contextual data for the survey as well as helped direct the consultant and establish contacts with the necessary groups. These informants are listed in Table 4.

Table 4. Additional Key Informants

Additional Key Informants
•2 researchers at SLARI
•2 faculty at Fourah Bay College
•4 officials at Ministry of Health and Sanitation
•1 Development Liaison w/ Freetown City Council
•1 Environmental Health Manager at Freetown Waste Management Co.
•1 representative of Japanese International Cooperation Agency
•2 major donor representatives
•1 Senior Advisor of UN Food and Agriculture Organization (FAO)
•1 representative of Welthungerhilfe (German NGO)
•1 representative of SL Environmental Protection Agency (EPA)
•President of National Association of Farmers - Sierra Leone

Focus Group Discussions

A total of 40 UPA farmers from 3 different regions (Western Urban, Western Rural, and Mountain) participated in 6 focus group discussions. Each focus group lasted a maximum of 2 hours and had between 6 and 8 participants, all of which received Le.

10,000 at the end of the sessions. All focus groups were held in locations convenient to the farmers, either adjacent to agricultural plots or at established meeting areas.

Per the recommendations of the Block Extension Officers and Ministry of Agriculture officials, focus groups were comprised of both women and men. Initial testing of two groups, one with all women and one mixed, revealed no observed differences in participation rates of males or females. Time available for the survey also limited the ability to do male and female-only groups in each area.

The objectives of the focus groups were to collect data on the following:

- Current soil amendment use (fertilizer, manure, compost)
- Knowledge around compost benefits and use
- Attitudes/perceptions towards compost made from human fecal sludge
- Willingness/ability to pay for this fecal sludge compost

Information collected from key informants within the Ministry of Agriculture was used to verify conclusions drawn from the focus group discussions.

3.3.2. Quantitative Data

Given the timeline and scope of the survey, the majority of data was qualitative in nature. Limited amounts of quantitative data were collected via individual interviews with UPA farmers and secondary sources gathered by the consultant.

Individual UPA interviews
Interviews with UPA farmers were conducted prior to any focus group discussions in order to gather the following information: land size/use, types and quantities of soil amendments used, and past expenses on these soil amendments. Questionnaire used to gather this information is provided in Annex VI.

Secondary Sources
To provide context and allow for basic quantification, project reports and background data on different companies and sectors were used (Mining company annual reports, for example). Unfortunately, there was only minimal information available in this form. Some information, like mapping and market access for UPA farmers, proved to be difficult in procuring from the respective researchers.

3.4. Limitations

Listed below are some of the limitations that should be noted in the data collection (focus group discussions in particular) as well as the resulting conclusions and recommendations made from this survey.

- Language barriers during focus group discussions: Focus groups were conducted primarily in Krio, with the enumerator at times paraphrasing

responses as opposed to providing literal translation. It is possible that some information or nuances were missed as a result.

- Lack of a product sample: No compost was available to show potential customers, so information and photos were shown of a similar project in another country. With no proof of the lack of smell, no results to show the compost's value, and no demonstration plots to show the effects, customer groups had little to base an estimated cost for the compost on.
- Moderator bias: Despite not speaking Krio, the consultant recognized numerous occasions where the enumerator was leading interviewees or focus group discussions in certain directions, which could potentially have influenced responses.
- Social acceptance bias: Individuals who had beliefs contrary to the larger majority, like the two UPA farmers who were concerned about health risks, were observed to remain quiet for the most part in the larger focus group discussions.
- Reliable data on land use in Freetown and the Western Area was not available, so numbers on estimated total demand could not be produced. While mapping has been completed for UPA sites in recent years, attempts at procuring this as part of the survey were unsuccessful.
- The co-composting facility wasn't in a state where it could be put in use during the consultant's stay in Freetown, as numerous modifications and hygiene infrastructure were necessary. As a result, potential organic solid waste materials were not tested with the consultant present, which means that there remains the possibility that additional investigation will be necessary on the part of the GOAL team if spent grains and sawdust are unable to achieve the necessary temperatures.

4. Results

4.1. Available Organic Solid Wastes

In order to reach the carbon to nitrogen ratio of approximately 30:1 necessary for thermophilic composting, an organic solid waste (OSW) must be mixed with the dried fecal sludge before being loaded into the compost bin. Identifying multiple sources of available local material that can support not just a pilot project but significant expansion in the future is essential. Each potential material should be analyzed according to its ability to facilitate the thermophilic composting process as well as its own ability to decompose and increase the value of the final compost product.

This review of available organic solid waste materials left out two other potential types of materials that other composting programs have had positive experiences with in other contexts: household organic waste and sugarcane bagas. The former was left out as the triage/sorting would involve a significant undertaking and could also potentially attract vectors (rodents) to the compost facility. The sugarcane bagas, on its part, was not included as no significant sources were located in and around Freetown and therefore transport costs would be high. If, however, the two materials mentioned below are unsuccessful, bagas and household waste could be revisited.

4.1.1. Brewery Spent Grains

A readily available organic waste material identified early on was the spent sorghum and barley grains produced by Sierra Leone Brewery Ltd., owned by the Dutch brewer Heineken and located in the Wellington industrial area. Producing an average of 16.4 tons of spent grains each week, Heineken spends a significant amount of money to transport it as free livestock feed to farmers in the Western Area. Demand from farmers does not match supply, however, and the excess "waste" is often dumped at the Granville Brook municipal site.

After a thorough review of literature, it was discovered that although spent grains are high in organic matter, the removal of carbohydrates during the brewing process may reduce the carbon to nitrogen ratio to as low as 12-17: 1. In addition, spent grains may need a coarser bulking agent in compost piles to ensure proper aeration of the pile. The spent grains, although initially regarded as a large source, may not actually create the necessary environment for high temperatures.

4.1.2. Sawdust and Wood Shavings

Located all over Freetown are formal as well as informal workshops that are producing everything from bed frames, doors, and tables to planks that will be taken to a construction site and used as siding. All of these workshops produce significant amounts of wood shavings and sawdust, which are either disposed of (legally/illegally) or burned nearby.

Three workshops in close proximity to the GOAL office and the Kingtom site were identified and interviews conducted with the respective owners. Two of these, which are representative in size of most workshops in Freetown, produce an average of 5 large bags/wk, or 7.5m^3. Given the proximity to the Kingtom site, the bags are transported to the dump site each week or when there is enough for one truck-load. AMTECH, a Lebanese owned business located directly in front of the Kingtom site, is one of the larger workshops in the western part of Freetown. This workshop has three different processing/working areas and they estimate that between 18 and 24 cubic meters of sawdust and shavings are produced each week. Although in the future they plan on acquiring the necessary equipment to produce plywood from the waste materials, currently they pay to have the "dust" taken to nearby Kingtom for disposal.

As a co-composting material, the workshop wastes (shavings and dust) are extremely rich in carbon, with a carbon to nitrogen ratio of around 500:1. Ensuring that there is proper aeration within the pile will be the main challenge, as there is the potential that a mixture of fecal sludge and sawdust will be significantly compacted, eliminating pockets of air that are necessary for microorganisms to survive. The smaller particle size of the sawdust makes it a good carbon source, but both the shavings as well as the dust may not promote sufficient airflow and therefore the piles may require an additional bulky organic material and/or regular turning.

Treated wood contains preservatives that have levels of arsenic and chromium, which are human carcinogens and should be left out of the composting pile. This will require sourcing from workshops that do not deal with the treated wood or communicating with workshop owners to separate these wastes before handing them over to the composting facility.

4.1.3. Recommendations:

The focus for organic solid waste materials during the survey was on sawdust/wood shavings and spent brewery grains, which were both found to be in large supply and not currently being used for other purposes in high quantities. Questions still remain about the porosity of compost piles that consist of mixtures of these materials and dried sludge, but small pilots will be necessary to test this. Additional materials that can be investigated in the event that spent grains and sawdust are unable to produce the required results include:

1. Household organic waste: This is in plentiful supply at Kingtom and the only issue will be the cost of separating organic and inorganic wastes prior to mixing with the dried sludge. This OSW has been proven to work effectively in co-composting systems elsewhere in the region (Cofie O., 2009).
2. Sugarcane bagas: This will be harder to source, as it is located at a distance outside of town, but it has worked well in other circumstances where static composting piles have been implemented (Kramer S., 2013).

4.2. Available Soil Amendments

Seven different types of soil amendments available in the Freetown area were identified via interviews with suppliers and customer groups. While speaking with both suppliers and customers allowed for verification of self-reported data, it should be noted that some information (ex: sales records) did not exist and therefore the self-reported data was accepted as valid for the purpose of the market survey.

4.2.1. Mined landfill soil, or "bome"

For more than 40 years, informal landfill mining has taken place at both the Granville Brooke and Kingtom sites. As much as 84% of the trash generated in the municipal area is biodegradable and, given sufficient time to decompose at the landfills, can be excavated and re-used as a soil conditioner (Gogra B.A., 2010). Loosely organized groups of laborers fill orders for the bome at these landfill sites and are responsible for the digging, triaging[1], and bagging of the soil.

Figure 1 Bome at Kingtom

Supply

Kingtom excavation is currently occurring in a 7-acre portion of the 20+ acre site that workers have identified as sufficiently decomposed and is not currently being used as a disposal area. As disposal areas move around the site, excavation locations rotate as well. Granville Brook site authorities report that due to low site capacity, soil excavation has become rare and customers prefer Kingtom.

Price

The bome is currently available in two forms: in unsealed 25kg plastic resin bags ($0.03m^3$) or by the truckload. Depending on the type of customer, the filled bags can sell from Le. 5,000 to 10,000. Truckload prices vary according to size, with a truckload of an estimated $4m^3$ priced at Le. 200,000. Transport is an additional negotiation, with customers reporting fees as high as Le. 200,000 per truckload for delivery to Hill Station.

Demand

Demand for the bome is somewhat sporadic, with spaces of days and even weeks between large orders. Sales are dependent on word-of-mouth, as there is no marketing done for the bome. Excavators report that although there is an increase in sales from March to May as people plant before the rainy season, customers request bome throughout the year. During a 4 week period starting on April 16th, the main organizer of excavations reported sales of 300 of the 25kg resin bags, or $9m^3$.

[1] Passing the soil through a make-shift sieve to remove non-biodegradable materials

Customers
Kingtom excavators report that customers include high-end hotels and resorts, construction companies, landscapers, florists, and individual homeowners. The largest orders, up to 15 truckloads at a time, are reportedly from landscapers with large contracts in the Freetown area. Local farmers were not reported as customers.

4.2.2. Palm Kernel Cake

Located in the Wellington area, the Marika Palm Kernel Oil company produces a widely-distributed cooking oil through processing of palm kernels, resulting in a large amount of waste pulp commonly referred to as "cake," or PKC. Marika has been bagging and selling the PKC as "Marika Organic Fertilizer," claiming to have found "promising" lab results of the organic material. Studies of similar PKC materials, however, have shown that it contains high levels of potassium and phosphorous and low levels of nitrogen. Much like manures, it must decompose before application, as not doing this risks creating an environment where the plant roots are competing with the cake for nutrients in the soil.

Supply
Although unable to provide information on the amount of cake produced during a specific period, cultivation and processing of the kernels happens throughout the year and Marika did not report any periods where demand exceeded supply. An estimated stock of 600 of the 50 kg rice bags (36 m^3) was observed along with a 55 by 18 square meter high-roof warehouse dedicated solely for palm kernel cake storage and bagging.

Price
PKC is currently sold in 50kg flour bags (0.9m^3), supplied by Marika, for Le. 25,000. Transport is the responsibility of the customer, although Marika has at times negotiated and provided transport for bulk buyers.

Demand
Marika representatives report that, on average, they sell between 40 and 50 bags each day, which would mean a weekly total of up to 300 bags, or 18m^3. Marika reported that there is no variation in the amount of sales per week.

Marika has filled two bulk orders in the past. The first; a 10,000 bag order in 2006 for the Ministry of Agriculture, and the second; an order of between 10,000 and 15,000 bags for the COMPLANT Magbass Sugar Company.[2]

Customers
Provincial farmers (10-60 bags) and marijuana growers (10-30 bags) were reported as the regular customers. Local farmers also purchase the kernel cake but at lower

[2] No records available and Marika could not remember exact quantity

quantities (maximum 10 bags) and at a less regular rate. UPA farmers reported that Marika has done small-scale free distributions of PKC during the past year to increase demand, but Marika reported that they are not proactive in marketing and rely on word-of-mouth to find new customers.

4.2.3. Chicken Manure

The "richest" of all animal manures, chicken manure contains high levels of nitrogen, which is essential for plant growth. The quality of chicken manure varies depending on the type of chicken (broiler has higher nutrient content than layer) as well as moisture content (dried vs. semi-dry). Despite Freetown poultry farms recognizing the differences in quality, only one of the interviewed businesses actually charge different prices accordingly. A list of the poultry farms identified in and around Freetown are in table 5 below.

Figure 2 Lumley Poultry Farm

Supply

Supply of chicken manure varies by poultry farm in terms of amounts and regularity. Gaps in supply often occur between large sales of grown chickens and the arrival of new orders. The smallest production reported was 30 of the 50kg rice bags every 6 to 8 weeks, while the largest was 100 of the same 50kg rice bags every week[3]. The latter, however, is currently only at 20 bags per week as this well-known company is transitioning to the water industry, which is believed to be a much more profitable business. The local poultry industry, despite the efforts of the Ministry and NGOs, struggles to compete with the powerful Indian poultry imports.

Table 5.

Business Name	Location	Phone
Doray's Poultry	Wilkinson Road	076-622-545
Yele Poultry	Allen Town	076-708-345
Pajah & I.J. Ltd Hatchery	Lumley	033-341-518
Greenfield's Farm	Lower Wilkinson Rd.	077-602-011
Hamilton Poultry	Hamilton	072-328-522

Price

The price for chicken manure ranges from Le 20,000 to 35,000 for a 25kg rice bag Le. 35,000 to 40,000 for the 50kg bags. Some poultry farms also sell two 50kg rice bags for Le. 60,000. Variations in price are often a result of relationships between local farmers and poultry farm owners, where prices are kept low to support local agriculture.

[3] One poultry farm owner who distributed to friends for free had ~20m^3 stocked but no record of production rate

Demand
Of the five poultry farms and hatcheries identified that sell the chicken manure, none are able to keep up with the demand. One poultry farmer who usually sells to local farmers has had to rotate customers each month so as to make sure they all are able to purchase. The local hatchery, on the other hand, has been approached for un-fillable orders as large as 1,000 50kg bags, and reports to often refer customers to other poultry farms, including a larger one in Waterloo[4].

Customers
As shown in table 6 below, while large agricultural projects have made the bulk orders, poultry farms report that vegetable, provincial, and marijuana farmers are their most regular customers. Poultry farms did not report traders as customers that they were aware of, but UPA farmers reported purchasing chicken manure through them for exorbitant costs (up to Le. 80,000 for 2 50kg bags) when transport was a prohibitive cost for purchasing it on their own.

Table 6. Poultry Farm Customers

Customer Type	Amount (50kg bags)	Frequency
Large Agricultural Co.	up to 1000 bags	infrequent
Vegetable farmers	up to 20	regular
Provincial farmers	up to 20	regular
Marijuana farmers	10-50 bags	regular
Landscapers	up to 30	infrequent
Traders, or "retailers"	unknown	unknown

4.1.4. Other Animal Manure (Pig and Cow)
Pig and cow manure were combined as the amount of these manures sold in and around Freetown are very low. Cow manure is found only on market days in Grafton and Wellington when they are brought in from the provinces. Although pigs are more common in Freetown, manure is sometimes hard to come by as pigs are often allowed to roam in order to feed. Both of these manures are quite low in nutrients compared to chicken manure or human manure but still provide soils with valuable organic matter. Pigs, however, share many intestinal parasites with humans and the manure therefore can pose a health risk to those using it.

Supply
For cow manure, approximately 10 of the 50kg rice bags worth is produced each week when an estimated 90 cows visit the Cabalah cow yard. At the larger cow yard in Grafton, however, there can be as many as ten times this amount each week.

[4] This poultry farm was not interviewed due to time constraints and reports that their customers are more provincial farmers than those in Western Area

A survey conducted by Bengal Agro, a Bangladeshi agricultural investment company, found 5 established piggeries in the Freetown area, with the largest having 100 pigs and two others with 50. This company was able to procure 700 of the 50kg bags worth of pig manure only by making rounds to all five piggeries and providing advances to owners to secure the entire manure production for the piggeries over a 2-3 month period.

Price
Pig manure is sold in 5 gallon buckets for Le. 10,000 and 50kg rice bags for Le. 15,000, although the customer supplies the bags (Le. 3,000). Cow manure is also very inexpensive, with 50kg rice bags sold for a maximum of Le. 10,000.

Demand
The demand for pig and cow manures is low. The Cabalah cow yard stated that the manure is more often gathered in a pile and burned at the end of each week than sold. Pig manure, for its part, is not perceived as high enough value in comparison to fertilizer and chicken manure for farmers to spend money on transport.

Customers
Both for cow manure and pig manure the most common customers are farmers that are located in the immediate vicinity. No company aside from Bengal Agro was found to have procured large amounts of pig or cow manure in the past.

4.2.5. Fertilizer

NPK 15-15-15, a mineral fertilizer with 15% available amounts of nitrogen/phosphorous/potassium, along with Urea, which has 46% available nitrogen, are the commonly used fertilizers in Sierra Leone. These are imported from a variety of countries, including Holland, Belgium, Guinea, and China.

Ministry of Agriculture officials state that despite a high level of understanding of the amounts needed, the vast majority of farmers are unable to purchase the appropriate amount of fertilizer for their land due to the high prices, a sentiment echoed throughout the focus group discussions. In it's campaign to "Close the (Yield) Gap," the Ministry is working to increase imports and use of chemical fertilizers nation-wide. This has lead to subsidy programs in recent years, where the Ministry has subsidized agricultural inputs such as fertilizer up to 40% its actual value.

Supply
Wholesalers and the large retailers are responsible for the bulk of fertilizer imports each year, although a lack of regulation/tracking at the borders and ports limits the amount of information available. Commodities Trading Company, a wholesaler supported by Louis Dreyfus Group[5], reported that the 300 tons imported in this first year dealing with fertilizer was insufficient and that the amount will increase as

[5] French global conglomerate involved in oil, energy, agriculture and commodities

they begin to understand the market. Large retailers buy in bulk (shipping containers) when possible and purchase from other large retailers to cover gaps.

Price

As shown in Table 7, the prices of the fertilizer vary depending on supplier but are often sold for the same prices per unit. Small scale traders were observed to play a significant role by purchasing fertilizer at retailers and re-selling this to farmers at marked up prices, although it was unclear whether this was a consequence of unwanted transport costs or a gap in knowledge regarding suppliers and price options.

Table 7. Fertilizer Prices (2012)

	Cup (250g)	**25 kg***	**Wholesale 25kg**	**50kg^**
NPK 15-15-15	Le. 1000-2000	Le. 100,000-130,000	Le. 87,500	Le. 200,000-240,000
Urea	Le. 1000-2000	Le. 100,000-130,000	Le. 83,500	Le. 200,000-240,000
Others: Potash, NPK 10-10-20, Agroblen, Cropmax, AgroPower Leaf				
* - Farmers report paying as high as Le 150,000, ^ - Farmers report paying as high as Le. 270,000				

Demand

Demand for fertilizer is in large part seasonal, with the bulk of sales between the months of April-June and November-January. In general, however, there is a high reported need for fertilizer, but sales are severely limited due to the high costs. All 40 UPA farmers interviewed reported buying fertilizer annually, although 33 of these stated that they were unable to purchase as much fertilizer as they wanted or needed for their land. One large retailer, whose sales info was not provided, complained that the Ministry should eliminate subsidy programs and work with importers to bring in bulk amounts, thereby lowering fertilizer cost and increasing sales to farmers around the country.

Customers

Customers vary by supplier, with wholesalers mainly selling to retailers that are located up-country (200-300 bags at a time) and large retailers selling to provincial farmers, large agricultural projects, and small retailers. Smaller retailers, located in the large markets of Freetown, are the primary source of fertilizer for the UPA farmers and traders, who then travel to the UPA sites and sell by cup directly to the farmers at their agriculture plots.

4.2.6. Compost

The only suppliers of compost identified were two florist/landscaping businesses that utilized portions of land where the nurseries were located to produce backyard compost. Ingredients to the compost included yard and plant debris, food scraps, and small amounts of chicken manure. One supplier had

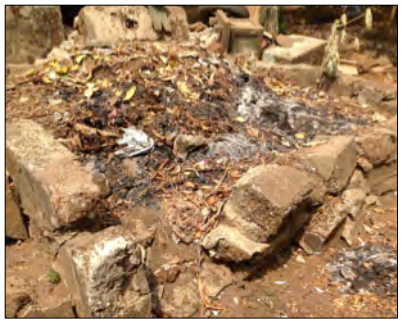

Figure 3 Cement Compost Bin

small compost heaps around his land, while the other made compost in unused cement bins.

Supply
Compost supply is extremely limited, with the larger supplier having a total compost production capacity of $12m^3$ every four months. Both suppliers cited lack of time, space, and water as the reasons they are not producing more compost.

Price
The compost is sold in 25kg rice bags, one supplier charges Le. 10,000 per bag while the other claims to charge as high as Le. 25,000 per bag. This higher price can be attributed to the difference in customer groups for each business.

Demand
Florists and landscapers both expressed frustration during interviews about the lack of compost, with one complaining that too often she calls one supplier to find none available. In addition, while 31 of 40 UPA farmers interviewed reported using their own homemade compost, focus group discussions revealed that the amounts actually produced were not sufficient for the amount of land being farmed.

Customers
Although the supplies are very limited, those that are purchasing what is available are UPA farmers in the immediate vicinity to one of the suppliers (1-3 bags), landscapers/florists (up to 20 bags), and private homeowners who buy the compost in combination with plants purchased at the business' nursery.

4.2.7. Summary

A summary of the soil amendments available in Freetown is found in Table 8. While chemical fertilizer is by far the most used as well as most expensive soil amendment, chicken manure is the most expensive organic amendment and identified poultry farms are unable to keep up with the regular demand.

Table 8. Summary of Available Soil Amendments

	Unit	Le.^	Customer Groups	Demand	Variation
Chemical fertilizer	50kg	220,000	Retailers, Traders, large-scale farming	High	Seasonal
	25kg	115,000	UPA farmers, florists, traders	Medium	Seasonal
	25kg*	85,500	Upcountry Retailers, large-scale farming	High	Seasonal
	0.25kg	1,500	UPA farmers, florists, landscapers	Medium	Seasonal
Chicken Manure	100kg	60,000	Large agriculture projects, provincial farmers, marijuana growers	High	None
	50kg	37,500			
	25kg	27,500	Local farmers, florists	High	None
Palm Kernel Cake	50kg	25,000	Local/provincial farmers, marijuana growers	Medium	None
Pig Manure	50kg	15,000	Large-scale agriculture projects, UPA farmers	Low	Sporadic
Compost	25kg	25,000	Private home-owners	Low	N/A
	25kg	10,000	Local farmers, florists/landscapers	Low	N/A
Cow Manure	50kg	7,500	Local farmers	Low	N/A
Bome	25kg	5,000	Landscapers, florists	Medium	None
	4m2	200,000	Landscapers	Medium	Sporadic

^Prices are expressed as averages. * denotes wholesale prices

4.3. Customer Groups

This section of the market survey is a review of the customer groups that are either currently using one or many of the previously profiled soil amendments or not currently using soil amendments but that could potentially be interested in purchasing compost in the future. The eight groups targeted were selected after compiling data and recommendations from key stakeholders, key informant interviews, and background research on local industries as well as case studies from other compost businesses from around the world.

4.3.1. Urban and Peri-Urban Agriculture (UPA)

As a result of the civil war, Freetown went through a period of rapid urbanization (15%) between 1990 and 2004, placing an increasing amount of pressure on already limited food supplies ((RUAF Foundation, 2009). Rural farming families found themselves in an urban context and began making use of available space for subsistence farming, leading to UPA activities being included as a major component to improving food security in the President's 2002 "Operation Feed the Nation" policy. Continued urbanization since that time, however, has resulted in development encroaching on land that has historically been used for farming. With the increased attention, Freetown City Council

Figure 4 Gloucester UPA

has helped the Ministry demarcate lands designated solely for agricultural use.

As of 2006, there were 1400 UPA farmers in the Western Area, although Ministry officials say that this number has risen considerably since. Although larger agricultural areas are located on the city outskirts and rural parts of Western Area, urban spaces for agriculture are also in high demand, allowing private landowners to charge high rent prices to those wanting to farm. A large percentage of UPA farmers, as well as provincial farmers, are organized into farmers' associations and farmer based organizations (FBOs). The National Association for Farmers of Sierra Leone (NAFSL), formed in 1987, works closely with the Ministry of Agriculture as an umbrella organization for FBOs and other associations. NAFSL organizes and advocates for FBOs around the country and works to build capacity through training and mobilizing much-needed resources.

Characteristics
Of the 40 UPA farmers interviewed, the vast majority are members of local farmers associations (32). In terms of land use, 26 farmers reported cultivating between 1,000 to 2,000 square meters, another 10 had less than 1000 square meters, and only 4 and had plots of over 2000 square meters. Only in the Mountain area did a portion of farmers (5) own the land that they farmed, with the 20 using government land and the remaining 15 using private land, 11 of which paid rents as high as 3,600/m^2 per year.

Current farming practices
Crops grown vary by area, with those in the lower elevations (rural and urban) primarily growing rice during the rainy season while those in the mountain areas preferring to grow "exotic" vegetables that can not be grown in other areas (sweet onions, running beans, carrots, cucumbers, etc.), throughout the year. Some crops, including the leafy greens referred to as plasas, are grown by all groups (potato leaf, crain-crain, etc.).

Soil amendment use
All 40 farmers interviewed purchased fertilizer last year, although 33 of them (83%) reported that these amounts were insufficient for the land being cultivated. While most (27) reported purchasing fertilizer by the 25 or 50kg bag, focus group discussions revealed that fertilizer is more often purchased by the cup (< 250g) due to problems with cash flow. BEO's report that, despite many farmers being grouped into associations and FBOs, fertilizer is purchased on an individual basis and not as a group.

Focus groups revealed that despite widespread understanding of the negative effects fertilizer has on soil, the general perception is that adequate yields can only be achieved by increasing amounts of fertilizer each year. Focus group discussions and interviews with area Block Extension Officers[6] revealed that UPA farmers have

[6] Ministry employee that provides trainings & manages area demonstration plots

a very good understanding around fertilizer application methods despite not being able to purchase the right quantities.

Animal manure
Chicken manure, perceived as the most valuable animal manure, was purchased by 33 out of 40 farmers last year. Those in lower elevation areas purchased more than those in mountain areas, as traders take advantage of the transport cost and resell chicken manure at Le. 80,000 in the mountains after buying it for Le. 35,000 at the lower elevation poultry farms. Pig manure was purchased in small quantities (up to 375kg) by 11 of the farmers, with focus group discussions revealing that more of this would be used if it was more readily available.

Compost knowledge
All UPA farmers interviewed had heard of compost, with 31 out of 40 producing their own in shallow pits with yard and household wastes. Knowledge of compost was limited primarily to its nutrient content, slower growth, and a perceived improved taste for food crops. A few farmers, who had undergone training with NGOs, pointed out compost's effects on pest control and water retention.

Fecal Sludge Compost
In all focus groups the idea of compost made from human manure was widely accepted, with concerns mainly revolving around the potential smell. 5 out of 6 groups included participants who had first-hand experience using dried, old latrine contents or knew of it happening in the past. Every group suggested that human manure compost was best used on vegetables, citing onions from the Lungi area that are currently grown with human feces and then sold in Freetown markets.

Health issues
Only two individuals in separate focus groups raised questions about health issues around using compost made from human manure, but the majority in both groups swayed their opinion, arguing that once it is "fully processed" there is no risk. Two focus groups insisted that even if there was any risk, all crops are washed before selling or eating because of the fertilizer, so the risk would be averted.

Reported Consumer Perceptions
While this survey did not specific evaluate the end user (those who are purchasing/eating the crops), participants in two focus groups did state that vegetables grown in Lungi (reportedly with dried human sludge) that are brought to Freetown markets are very popular and thereby hard to find. No participant expressed any concern about not being able to sell crops that were grown with compost made from fecal sludge.

Barriers
Although discussions about the sale of compost focused on determining the value of compost in relation to other soil amendments, the primary concerns of UPA farmers are the unit costs and the distance from farmers' plots to the point of purchase.

Engaging the Ministry of Agriculture to purchase in bulk and transport to farmers, even perhaps providing a subsidy was suggested as a long-term strategy. In the short-term, focus groups suggested a starting price of Le. 10,000 to 20,000 for a 50kg rice bag of compost until the value can be determined and demand created.

4.3.2. Large-scale Agriculture

As the survey focus was within the Western Area, only two large-scale agricultural companies with activities in the provinces were interviewed: Complant Magbass Sugar and Bengal Agro Ltd. These companies' business strategies are very different. Magbass is focused on short-term returns, hiring employees on a three-year cycle, Bengal Agro, however, is working to create a more sustainable model for others to follow, maximizing crop yields and improving soil fertility while producing only 100% organic crops.

Figure 5 Sugarcane Plantation

Both of these companies are currently managing large plots of land. Magbass' sugar plantations are set on 4,000 acres and are located in Magbass, which is approximately 170km northeast of Freetown. Bengal Agro's land is an estimated 2,000 acres and is located in Lunsar, approximately 95km northeast of Freetown. This land is currently planted with a variety of crops (ginger, turmeric, rice, groundnut, sesame, maize, castor, and rubber), but they are waiting for government approval for a rubber plantation that would be set on an additional 18,000 acres.

Soil Amendment Use
Demand for soil amendments for both companies is very high. Magbass currently imports 1,000 tons of fertilizer from China (net importer) each year at a very high cost and are currently looking for other alternatives. Bengal Agro uses no chemical fertilizers and instead uses local animal manure and practices "green manure" techniques.[7] For animal manure, Bengal Agro reported brokering exclusive purchasing deals with all of the known Freetown piggeries, gathering 700 of the 50kg bags over a two-month period for use on 7 acres of land.

Compost knowledge:
Both of these companies have an in-depth understanding of compost and would both be interested in testing quantities of the fecal sludge compost to determine the actual value and recommended application rates.

Fecal Sludge Compost:
Acceptance of fecal sludge compost for these companies is high, with Magbass' concerns limited to the results on crop yield and Bengal Agro interested in ensuring that there are no **inorganic** components to the compost. Both companies reported

[7] Planting nitrogen-fixers and turning plants into soil to improve fertility

needing to conduct in-house experimental plots to determine the compost value before seriously discussing prices and bulk purchases.

Potential Demand
Despite Magbass' need for a replacement to their expensive fertilizer, the demand for fecal sludge compost would most likely be low, as it will not provide the short term yields that they are looking for. Bengal Agro, however, could have a high demand for this compost as the options for organic amendments are low and the land that they are rendering fertile is vast.

4.3.3. Real Estate and Construction

Data was collected from two construction companies, two real-estate companies (one Chinese and one Ghanaian), and three architectural firms. The architectural firms, although removed from direct implementation, provided helpful insight and information on landscaping and soil amendment use within the construction and real estate industries.

The real-estate companies interviewed dealt with high-income clients, developing gated communities with houses that can be sold for up to 1.8 million dollars (USD) as well as malls for higher-end retail stores. The construction companies, on the other hand, reported working on contracts for NGOs, local companies, and occasionally the Government of Sierra Leone.

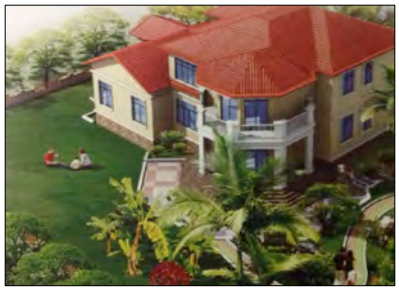

Figure 6 Flyer for West African Sunshine Development

Landscaping
Both construction companies reported a low demand for landscaping work, stating that the need for water access and maintenance often resulted in clients preferring "hard" landscaping. Combined, these companies estimated that a total of 2-3 projects per year would require only a limited amount of landscaping.

Real-estate companies, however, place a high priority on green spaces. The Chinese real estate site visited, which is comprised of 21 residential buildings and an area of over 6,500m^2 to be landscaped, is one of three Freetown sites being developed. The second, a Ghanaian company who ensures each project has green spaces, is currently working on 4 projects, one of them a gated community that has both apartment buildings and individual homes set on 18 acres of land.

The companies included in this portion of the survey subcontracted all landscaping and beautification work, with two preferring to use local gardeners while the other two had formal landscapers that they used for each contract.

Soil Amendment Use
Some soil amendments varied between subcontractors, from one using dustbin "compost[8]" to the subcontractor for the Ghanaian company using Miracle-Gro that she imports on her own. All of the companies, however, source bome for their contracts, with subcontractors including it in the price of their services. At the site where dustbin compost was being used, a management representative reported that wealthy homeowners were becoming impatient with the poor quality of landscaping and wanted to take responsibility for their individual plots.

Fecal Sludge Compost
All of the gardeners and management representatives interviewed expressed interest in testing the compost. The Ghanaian real-estate company was not interviewed, but their subcontracted landscaper had previously expressed interest. One gardener reported concerns with potential smell, but otherwise said that it would be beneficial for the grass and the plants.

Demand
Although these companies will not be using soil amendments themselves, they are decision makers regarding landscaping and amendment purchases. High-end real estate companies like those interviewed could provide a high demand for compost as they establish new developments. With a recommended minimum application of a 2.5cm layer for establishing new turf, for example, contracts like the 6500m^2 mentioned previously would potentially require 162 cubic meters of compost (The US Composting Council, 2001).

4.3.4. Florists

Seven florists were interviewed, with plant stock estimates ranging from 500 to as high as 10,000. Only one of the florists reported plant sales being the main source of income, however, with the rest rely on landscaping activities (which result in plant sales, too). The majority of species available for sale are ornamental flowers and trees, with a very limited amount of fruit trees at three of the florists.

Sales
All but one of the florists reported sporadic sales, with three florists reporting estimates of 100-200 plants per month and slightly higher numbers in the months preceding the rainy season. Those that buy the most plants at a time were reported to be contractors (up to 50) and embassies or other official buildings (20-30), although one florist claimed to have sold thousands of a certain tree species to the Libyan embassy in the past. The one florist that reported regular sales dominates the market niche for


Figure 7 New England florist

[8] Like bome, this is decomposed and/or burned waste collected from trash bins

wedding and funeral arrangements, but declined to provide specific details on sales.

Current use
Soil amendment use by florists varies from using nothing at all to very sophisticated potting mixtures that include chemical fertilizers, sand, charcoal, and sawdust. One florist reported using small amounts of Kingtom bome, while two others reported to have done this in the past but stopping because of its poor quality. While all of the florists reported using home-made compost, only the florist providing wedding and funeral services reported using fertilizer, spending up to 1.3 million Leones each year for NPK fertilizer. Three of the florists also used small amounts of chicken manure, which was then mixed into potting soils.

Compost Knowledge
Understanding of the benefits and application of compost varied, with the higher-end florists having a much more in-depth understanding of the benefits as well as how to properly apply the compost. Three of the florists, however, referred to decomposed and/or burned material pulled out of trash bins as their compost.

Fecal Sludge Compost
All of the florists responded positively to the idea of compost made from human fecal sludge, with all but one agreeing to test it[9]. The florist that provides services to funerals and weddings believed that there would be health risks associated with using this compost on food crops, but all of the florists stated that it would be safe and valuable fertilizer for their plants. Two of the florists reported having used dried fecal sludge in the past with positive results. All seven of the florists recommended initially selling this compost at Le. 10,000 to 20,000 per 50kg bag until people understood its value.

Demand
Three of the florists interviewed stated that the amount of home-made compost that they produce is "enough" to supply the plants within their nurseries. While the other four florists expressed a desire for compost, the amounts needed would be quite low. Two of the florists currently facilitate the sales of Kingtom bome for customers buying flowers (up to 40/month), and both suggested that they would be interested in selling the compost if there was a demand for it.

4.3.5. Landscapers

Of the seven landscaping businesses interviewed, four were categorized as "formal," characterized by active business promotion through flyers and social media (websites, Facebook pages) while also being involved in the larger, more high-visibility contracts. Clients for these businesses include private homes, company offices, real estate companies, and government buildings. Informal landscapers work primarily with homeowners and small businesses, earning contracts either

[9] One believed it was better suited to vegetables, which he does not grow or sell

through word-of-mouth or by individuals purchasing plants from the business' nurseries Formal landscapers suggest that these contracts are often a result of homeowners unwilling/unable to pay higher fees for more formal businesses.

Scope of business
Formal businesses reported little variation in demand for their work, as they require clients to have access to sufficient water throughout the year, allowing landscape projects to be implemented during both the dry and rainy seasons. The largest of these businesses reports having up to 9 contracts at a time, with each contract lasting from a few weeks to 3 months before handed over to the client.

Informal landscaping businesses, on the other hand, experience seasonal variation, and have more contracts in the months leading up to the rainy season as clients take advantage of the coming rains. These businesses are able to take on 2-4 contracts at a time, usually spending only a few weeks to a month at a time on each contract.

Current soil amendments
Six out of seven landscapers interviewed use the Kingtom bome for their landscaping jobs, despite formal landscapers complaining about its poor quality. Informal landscapers report purchasing up to 5 truckloads ($20m^3$) at a time for larger contracts while formal landscapers have needed as many as 15 truckloads for big contracts ($60m^3$). Two landscapers also reported using small amounts of chemical fertilizer (NPK, Miracle Gro) when establishing lawn turf.

Compost knowledge
A high understanding of compost, its proper application, and the variety of benefits was observed in formal landscapers, while informal landscapers were found to regularly confuse compost with animal manure and able to identify only the nutrient content benefits associated with it. Two informal landscapers reported proper application methods similar to chemical fertilizer (light surface application).

Fecal Sludge Compost
All of the landscapers expressed interest in using compost made from fecal sludge, although three of them stated that they would want to "see results" before deciding on whether to purchase it. None of the landscapers expressed any health risks associated with using compost made from fecal sludge. It was agreed that, until the value of the compost is realized, the compost should be sold in 50kg rice bags and be sold at the price of the landfill soil or a little higher (up to Le. 20,000 per 50kg bag).

4.3.6. Hotels

Gardeners at three established hotels and one undergoing renovations (Mammyoko becoming the Radisson) were interviewed in addition to two managers.[10] Rooms at

[10] A third declined, saying that only the gardener knew anything about the landscaping and soil amendment use

these hotels started at 100USD and went as high as 550USD per night. These hotels were selected from a number of possible hotels due to the increased amount of green space currently being managed. Many of the previously-high end hotels sitting on large pieces of land have gone into disrepair since the civil war and have not been re-opened. The Radisson will be the first, which sits on 16 acres of relatively unkempt land.

Current soil amendment use
The hotels sampled use very low amounts of any type of soil amendment, with one reporting that no soil amendments are used at all. Only one hotel reported buying small amounts of fertilizer each year (up to 10kg in total). Two of the established hotels source small amounts of bome each year, ordering up to 25 bags at a time, but this was very sporadic and months go by between purchases. Both gardeners also stated that there is little space remaining for new plants. The highest amount spent on soil amendments in total for one year was approximately 200 USD.

Compost Knowledge
Only one of the gardeners interviewed could identify benefits of compost beyond it acting "like fertilizer" while differing in that it is natural. There was a basic understanding of how to apply compost, however, with all gardeners reporting to mix compost with soil prior to use as a potting mixture.

Fecal Sludge Compost
While all four gardeners stated that they would be interested in testing the compost out, two of the respondents had concerns about the potential smell. One of these gardeners had experience using human manure in the past and said that although the plants responded really well, he had problems with smell in the rainy season when his potted plants were flooded. None of the gardeners reported any health issues or concerns around using compost from fecal sludge. Three out of four gardeners stated that they would need to see how the compost does before recommending a price.

Demand
The amount of soil amendment use by these hotels is very low, and with the exception of the Radisson this should not be expected to change. The gardeners at the three established hotels report that managements' lack of interest, not resources, are why more resources are not allocated to them (one even complained of the hotel forcing him to use highly-chlorinated water from the pool for plants).

The development of the Radisson, however, is an exception to this stated low demand. Sitting on approximately 14 acres, the future Radisson management expressed a need to source large quantities of soil amendments to "green" the space to the standards of 5 star international hotels, including developing a garden that provides the restaurant(s) with a variety of food crops. Management expressed interest in using compost made from fecal sludge as long as there was no smell

associated with it, citing the American hotel chains' recent attempts to "go organic" at their hotels around the world.

4.3.7. Freetown Golf Club

Founded in 1904 and then moved to its current location in 1930, the Freetown Golf Club is the only Sierra Leone golf club that is functioning since the civil war. An 18-hole course set on over 60 acres of sandy soil on Lumley Beach Road, this institution is slowly building back its membership and trying to improve the state of the course.

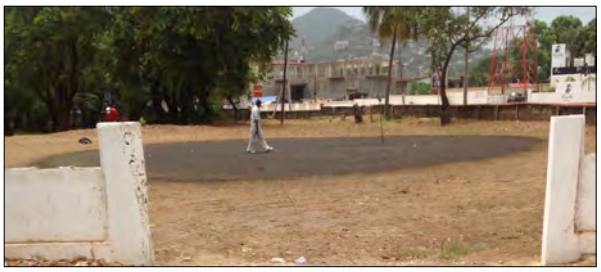

Figure 8 Golf Club 18th Hole

The course suffers not just from the sandy soils but also from a lack of water, where only during the rainy season do the fairways turn green. As a result, the putting greens are instead a compacted mixture of soil and tar and referred to as the "browns." With membership down to 130 from a pre-war peak of 250 and annual dues of only Le. 825,000, the club management reports being able to only make small improvements to the course each year. This has translated into two wells being dug in the past year, providing sufficient water to the clubhouse for the first time as well as providing water to a small portion of the course that usually relies on rainwater.

Soil Amendment Use
The current manager used a small but undisclosed amount of imported Chinese fertilizer around the clubhouse this year as a trial. Compost is made in pits around the course (reportedly six areas that hold a maximum of $3m^3$ each) and applied before the rainy season by the gardeners.

Compost Knowledge
Despite the compost being produced around the course, the observed method of application was a light surface application and suggestions to turn larger amounts of the compost into the soil for better results was met only with a defense of the current application methods. The gardener interviewed was not able to articulate the benefits of compost outside mimicking the effects of fertilizer, instead blaming the lack of results on the sandy soil and lack of water.

Fecal Sludge Compost
Both the management as well as the gardener expressed that they would be interested in trying the compost made from fecal sludge, as they are searching for ways to improve the course and keep the grass beyond the rainy season. How it is made, in their opinion, was of low concern compared to the results that it could produce.

Demand
The potential demand for compost at the golf course is high. The club manager expressed a need to focus on providing grass around the greens, which if properly applied (4-5cm layer, tilled into soil) would require up to 38m^3 to provide a small grass band around each of the 18 greens (The US Composting Council, 2001).[11]

Triggers
In order for the golf club to be purchase compost, it's effectiveness in turf establishment would need to be proven. In theory, compost application would increase the sandy soil's retention of water and nutrients, reducing amount of irrigation and chemical fertilizer needed. Given the gardener's lack of knowledge around compost, however, this would require a demonstration plot, set-up and managed by a different party, to prove effectiveness to the club while also serving as a guide for the gardener. An advantage, however, is that the Golf Club is located only a short distance away from Kingtom and the GOAL office, on Lumley Beach Road, which allows for easy follow-up.

Club management was concerned that they would not receive a reasonable price for the compost, stressing that they are struggling financially. No price was recommended, however, as management claimed to not be in a position to respond to the question[12] and suggesting that members would first need to see results.

4.3.8. Mining Companies

Sierra Leone has rich deposits of a number of minerals, including diamonds, iron ore, rutile, bauxite, and gold. Three of the more well-known mining companies are London Mining (iron ore), African Minerals (iron ore) and Sierra Rutile (rutile). According to the Environmental Protection Agency, each of these companies is contractually required to engage in "progressive rehabilitation," where the amount of land the degraded each year is matched by the amount that is rehabilitated. A 2012 assessment of 8 different rehabilitation sites revealed that soil substrates at some rehabilitation sites have low regrowth potential (Franks D., 2012).

Recycled organics have been shown to provide benefits for mine rehabilitation as a soil amendment, a topsoil replacement, and fertilizer. Lack of nutrients and unstable soils are two common barriers to re-vegetation of rehabilitation sites, and compost's ability to replenish organic material as well as it's slow release of nutrients makes it an ideal component to land rehabilitation programs (Kelly, 2006).

Soil Amendment Use

Both Sierra Rutile and African Minerals reported that soil amendments purchased were limited to chemical fertilizer and low amounts of manure local to the sites.

[11] Assuming greens with a diameter of up to 6m
[12] Club members are the owners and decide on finances as a group

Details on the amounts of each of these soil amendments used, however, were not provided. Like most mining operations, however, topsoil removed during the initial stages is often the bulk of what is used for rehabilitation.

Compost knowledge
Although this was not assessed, it is worth noting that Sierra Rutile is currently working on mine rehabilitation research with the Sierra Leone Agricultural Research Institute (SLARI) which would be able to provide specific recommendations on compost use for different soils.

Fecal Sludge Compost
All three companies[13] expressed interest in purchasing fecal sludge compost for use in land rehabilitation activities, although only with Sierra Rutile were there more in-depth conversations about this possibility. Although this was the first time the notion of fecal sludge compost had been proposed, Sierra Rutile reported no concerns and wanted to know more about the make-up of the compost as well as associated costs.

Demand
The potential demand for compost by the mining companies is extraordinarily high. Sierra Rutile is rehabilitating 150 hectares/year while African Minerals reports land rehabilitation in 2012 including erosion control along over 353,000km of rail embankment as well as a tree planting pilot across 12 hectares of land. London Mining, for its part, currently has licenses for an area of 319km^2 (Baker H., 2009).

Barriers
Although Sierra Rutile stated that the compost's value would need to be proven before any conversation about large purchases, the major barriers would be the costs associated with purchasing and transporting the compost from Freetown to the mine sites (main sites range from 135 to 190km from Freetown). In addition, there would need to be a significant amount available for this to be appealing to Sierra Rutile and, most likely, any other mining company.

Triggers
A potential strategy to trigger purchases from mining companies would be to appeal to the Corporate and Environmental Stewardship responsibilities, emphasizing how purchasing this compost would be supporting sustainable waste treatment in Freetown. As these companies often deal with negative publicity, sourcing valuable compost for land rehabilitation could be an attractive opportunity not just for improving rehabilitation practices but also public reputation.

[13] Only a brief phone conversation with London Mining

4.3.9. Customer Group Summary

A summary of each customer group is provided in Table 9 below. For the purposes of the summary, real-estate and construction companies were separated, as were the "formal" and "informal" landscaping businesses.

Table 9

Customer Group	Current SA Use	Potential Demand	Frequency	Ability to Pay	Willing to Pay	Compost Knowledge	Distance
UPA Farmers	animal manure, fertilizer, compost	High	Seasonal	Low	Low	Med	Varies
Large-scale Farming	animal manure, fertilizer	High	Seasonal	Med	Med	High	> 95km
Real-estate	compost, bome, fertilizer	Medium	Sporadic	High	Med	Med	Varies
Construction	bome	Low	Sporadic	Med	Low	Low	Western Freetown
Florists	compost, bome, fertilizer, animal manure	Low	Sporadic	Low-Med	Low-Med	Varies	Western Freetown
Formal landscapers	bome, fertilizer	Medium	Regular	Med-High	Med	Med-High	Western Freetown
Informal landscapers	bome	Low-Med	Seasonal	Low	Low	Med	Western Freetown
Freetown Golf Club	fertilizer, compost	High	Cyclical	Med	Med	Low	Lumley
Hotels	bome	Low	Sporadic	High	Low	Med	Western Freetown
Mining Co.	fertilizer, animal manure	Very High	Regular	High	Med	N/A	> 135km

To note, UPA farmers and informal landscapers both have a low ability to pay as well as willingness to pay. At the same time, there are groups willing and able to pay for the compost once the value/results are shown, including real-estate companies, mining companies, large agricultural companies, and some formal landscapers.

5. Conclusions

Imported chemical fertilizer is the most expensive amendment available in the Western Area and despite strong demand there is little issues with supply. Chicken manure was the most popular of the remaining amendments, with poultry farms unable to keep up with demand. Significant supplies of palm kernel cake and bome, however, were found but past experiences with the Ministry of Agriculture (PKC) and concerns with quality (bome) appear to limit the potential demand for these amendments. Low-quality compost of limited supply is also sold in Freetown.

All customer groups identified indicated approval and acceptance of the use of compost made from fecal sludge, with most recognizing the potential nutrient value and related benefits. The only common concern reported was potential offensive smell, and there was no change in acceptance by different religious beliefs or socio-economic status. The focus of most customer groups was on the types of results (yield, healthy turf, etc.) that the compost would show. In terms of customer groups' perceptions of end consumer acceptability, this was limited primarily to the potential smell (especially during/after rains). UPA farmers, on the other hand, claimed that vegetables that are widely reported to be grown with dried human fecal sludge are popular items at the markets in Freetown.

There appears to be a strong demand for the compost across multiple customer groups identified. Mining companies, large-scale agriculture companies, and formal landscapers were shown to have potential demands for large volumes of compost and also had higher perceived ability *and* willingness to pay, making them attractive groups to target. While other groups showed high demand (Freetown Golf Club, UPA farmers) or ability to pay (Hotels), the willingness to pay was low, meaning that they could be potential customers in the future but perhaps not in the short-term.

In general, there was little understanding about potential health risks that could come from using compost made from fecal sludge. Farmers, in particular, emphasized that human manure compost is best suited for vegetables, which are categorized as high-risk crops. This emphasizes the need for strict monitoring and pathogen testing prior to any sales or distributions.

A significant amount of time was spent exploring the potential of UPA farmers as a customer group, as agriculture is a mainstay of the economy and the idea of supporting local farmers is an attractive one. As a group, UPA farmers having a strong need for compost as a soil amendment, but relative to other customer groups their ability and willingness to pay are low. In addition, UPA farmers are the sole customer group that would be using the compost in a "higher risk" manner, planting food crops that are low to the ground and/or producing at the roots. While these reasons do not eliminate UPA farmers as a potential customer group, it does signal that it would be more appealing to target other groups first and have this group be a long-term option if/when the Ministry of Agriculture is also involved.

Large-scale agriculture activities could, in some cases, be categorized as higher risk, but Bengal Agro would be managing rubber plantations while Magbass sugarcane is processed for the ethanol as opposed to being eaten raw. All other customer groups fall into the ideal "low risk" category, with intended use involving turf establishment, potting soils, and establishment of wood lots at mine sites.

6. Recommendations

Based on the data collected and accompanying analysis, a number of recommendations are made below regarding how fecal sludge compost could potentially be introduced into the soil amendment market in the Western Area.

It should be noted that to whom fecal sludge compost should be sold to will be dependent on the ability to produce a **safe** product of **consistent value** in quantities that match the demand of the specific customer. Ensuring safety will only be achieved through proper monitoring as well as regular testing for pathogens. The market survey was conducted based on the assumption that GOAL would succeed in achieving this.

6.1. Testing

To whom GOAL and other entities can sell the compost to will be dependent on the ability to produce a **safe** product of **consistent value**. To ensure safety, the compost should be tested for pathogens prior to any being sold or distributed. Once pathogen testing has shown that the compost continues to be pathogen free, a protocol for testing should be established with local officials (FCC, Ministry of Health and Sanitation) to ensure sufficient control over the safety. Although it is imperative to test early on for *ascaris*, in the future this could potentially be replaced more regularly by the less demanding *e. coli* testing. More information regarding laboratories that could provide this testing are included in Annex II.

To determine compost value, soil analyses should be done in conjunction with demonstration plots, the latter of which can be done both through formal collaborations with SLARI or by hosting agricultural internships from Njala University.

6.2. Early Adopters

A low-risk approach to testing various customer groups can be implemented by first selecting one or two representatives from each (below) that have both a high understanding of compost as well as a willingness to experiment with samples. These representatives should be approached directly by GOAL and quantities of compost provided free of charge. In return, these representatives would do in-house trials with the compost and provide GOAL with honest feedback and

recommendations regarding the quality as well as the marketing of the product (including the price). This approach allows GOAL not only to benefit from the expertise of the various representatives but also to develop relationships with potential trendsetters of the various groups.

6.3. Customer Groups

The following customer groups are, based on the data collected from the survey and taking in to consideration a variety of factors, the groups recommended to target as potential buyers of compost:

1. Formal Landscapers
   Although not pleased with its quality, formal landscapers continue to source bome from Kingtom because there is no other amendment on the market. Compost could potentially fill this gap, providing a quality amendment (at a higher cost) that would show results both for turf establishment and tree planting. These landscapers are also knowledgeable regarding compost application, and would be able to provide feedback on effectiveness. Adoption by this group would also create in-roads to high real-estate companies who provide them with contracts for large jobs. Many landscapers double as florists and could source amounts for their nurseries as well.
   Suggested Early Adopter: Eskarnn Flowers and Landscape Design

2. Large-Scale Agricultural Companies
   Despite only interviewing two companies, it is clear that opportunities exist for engaging them as customers. While Magbass may be harder to attract given their focus on short-term yields, there is a potentially incredible opportunity to engage Bengal Agro, a niche company that has already shown the lengths/costs it will go to in sourcing organic amendments like pig manure. Bengal Agro is extremely knowledgeable about compost benefits and application and could provide valuable insight and feedback regarding quality. Focused on sustainable development and improving soil fertility, Bengal Agro could become a very important partner.
   Suggested Early Adopter: Bengal Agro SL, Ltd.

3. Mining Companies
   No other group has a potential demand that can match mining companies, which are involved in massive land rehabilitation activities and using primarily topsoil and chemical fertilizer. As these companies would require high volumes of compost, it is a long-term opportunity for compost re-use. Although transport costs to mine sites over 100km could be an issue for the mining companies, opportunities to publicize supporting sustainable waste treatment in Freetown could potentially appeal to Corporate Responsibility branches of these companies that expend large sums of money to maintain positive public images. Working with the EPA and SLARI, who is currently

doing rehabilitation pilots with Sierra Rutile, could lead to organic amendments being encouraged in place or alongside chemical fertilizers.
Suggested Early Adopter: Sierra Rutile

4. Golf Club
   Despite the lack of compost knowledge observed, the Freetown Golf club is a potential customer that should not be passed up. The golf club represents a local, potentially high-volume customer that, although stating they are in a difficult financial situation at the moment, could be encouraged to invest significantly in the compost if it is shown to bring results. The key to this potential customer, will be to have control over the demonstration plot so that the results AND proper application methods are used.
   Suggested Early Adopter: Freetown Golf Club

5. High-end Florists
   Given that GOAL will only be producing small amounts of compost in the early stages, florists could potentially be an ideal target group. By targeting the higher-end florists that have an increased understanding of compost, it's value could be assessed and the demand would be relatively low. Assuming satisfaction with the product, florists could then source the compost for their landscaping operations as production increases.
   Suggested Early Adopter: Awuna Florists

6.4. Composting Promotion

Composting of fecal sludge and the notion of not only using the final product but putting it on the market for sale is new to Sierra Leone. In meetings with numerous officials both in the Ministry of Health and Sanitation as well as the Ministry of Agriculture, there was minimal knowledge of this approach. These meetings, while designed as key informant interviews also doubled as marketing "pitches," explaining the composting process and related benefits in a convincing manner.

As the pilot moves forward and gains more attention, it will be necessary to keep communications clear with Ministry representatives and update them on progress. This will prevent any backlash in the future that comes from misunderstanding or lack of knowledge regarding both the effectiveness of composting and safety concerns around the final product.

Initial meetings with Ministry officials over the course of this survey generated a good amount of interest in the pilot and the potential for compost use in the future. In the event that the pilot experiences sufficient success and the compost begins to sell, it will be the responsibility of GOAL and the entity that will eventually manage the composting facility to balance the inevitable pressure of taking the project to scale while also maintaining a safe product of consistent quality.

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Annex I. Review of Oxfam Urine-Diversion Double-Vault Toilets (UDDT)

The consultant was asked to review the re-use component of Oxfam's urine-diversion double-vault toilet (UDDT) project that was implemented in 2012 as part of the first phase of a DfID-funded WASH programme. This project involved installing 75 permanent UDDTs in five different areas of Eastern Freetown (Mayinkineh, Robiss, Tonda Hill, Grassfields, and Pamburonko) where sanitation coverage is extremely low.

Figure 9 Tonda Hill UDDT

The Oxfam UDDTs are permanent structures that use a urine-diverting squat pan that has openings for urine, feces, and water used for anal cleansing. The capacity of each of the two vaults is approximately 0.8 cubic meters[14], and Oxfam staff reported that the vault capacity was designed to allow for a six month storage time.

Oxfam provided initial trainings for all beneficiaries and has provided regular follow up. The current monitoring program involves a weekly visit of each site by a member of the Oxfam team. Beneficiaries have been instructed to use household kitchen ashes for a cover material and to prevent any water from entering the vault below. The UDDTs in these project areas were opened between October of 2012 and February of 2013.

Objectives:

- Specifically look at the way in which compost can be taken from Oxfam eco-san latrines when necessary and stored in compost bags for use on the garden plots when fully composted and as needed. Provide recommendations on how this process should be managed and delivered
- Investigate if a small income can be raised through the sale of this compost to facilitate the on-going supply of composting bags.
- Details what objections or challenges would arise within the community from using human fertilizer for food –crop production.

Methodology:

To complete the stated objectives, the following activities were carried out:

- A review of project reports and previous evaluations
- Site visits with Oxfam WASH engineer to selected UDDTs in Tonda Hill, Grassfields, and Pamburonko
- Individual interviews and focus group discussions with 32 beneficiaries across the five project areas (templates can be found in attached annexes)
- Interviews with Oxfam Hygiene Promotion staff

[14] Outer dimensions: 1 x 1.5 x 2.4 meters, walls 15cm thick and slab 15-25cm thick

Results:

Thirty-two family representatives, ranging from 18 to 62 years of age, participated in the interviews and focus groups. There was an even, though unplanned split, between those who currently practice Christianity (16) and Islam (16). Two of the representatives reported not yet having used or opened the UDDTs, one as a result of too many potential users and another because of the toilet's close proximity to the family kitchen. The majority of participants reported to own their current home and land (25) and had lived in the same for over 5 years (24).

Figure 10 Grassfields Focus Group

Information gathered from the interviews and focus group discussions were grouped into two categories: sanitation and agriculture.

Sanitation:

UDDT Use

While the average amount of UDDT users within *each beneficiary family* was 10, the majority (25) reported to have additional families also using the toilets. Over half (17) claimed that there were more than 16 total users for their toilet and two that reported there were "too many" and could not provide a reliable estimate. None of the participants reported content levels in vaults reaching half-way and the few visits by the consultant to the UDDTs revealed nothing to the contrary.

Understanding of the UDDTs

Focus group discussions and site visits revealed a high understanding of appropriate use and maintenance of the UDDTs. Although there was initially confusion and frustrating with the diversion of the urine and water being "too technical," participants said that over time they became accustomed to this. All participants use cooking ashes as a cover material, although 21 out of 32 did not know of any other material (soil, sawdust, etc.) that could be used in place of this. Five of these participants reported having to sourcing additional ashes from merchants and neighbors to ensure adequate supply.

Figure 11 Oxfam urine-diversion pan

Acceptance of the UDDTs

Focus group discussions revealed mixed reviews of the EcoSan toilets. The majority of participants recognized the benefits of the UDDTs: the lack of smell or flies, the hygienic nature

of the chamber, and improved safety for young children, and the potential for content re-use. There were numerous complaints, however, that not all members of the family could use the UDDTs, as elderly individuals were not able to comfortably squat and children would too often use it improperly. Adhering to the initial training provided, participants reported that young children's feces that are collected in buckets or other receptacles are not disposed of in the vault due to its liquid content.

Waste Management

21 of 32 participants reported having a toilet in the past, but only six had ever paid for latrine emptying[15], which was an expense of between Le. 250,000 and 800,000 for families. Manual emptying of latrines is a common practice, where contents are emptied into a nearby shallow pit and covered. The rocky terrain makes this difficult and expensive, however, and individuals reported that emptiers sometimes use the waterways, nearby gulleys, or the oceanfront during the rainy seasons for disposal. Mechanical emptying was reported as rare due to solid waste regularly found in the latrines as well as service providers preferring to work in higher-income areas where higher fees could be charged.

UDDT emptying

The general consensus in all focus groups was that Oxfam will facilitate the emptying of the UDDTs for the foreseeable future. Participants report that, as long as the toilets are managed properly, the contents will be dry after a 6 month period and ready for removal and re-use. Different materials have already been distributed by Oxfam to facilitate future emptying, and participants stated that they are ready to learn from Oxfam how the emptying can be done. The common belief is that there will be no cost to this process but a potential income, as households can empty the vault contents into bags and then sell the manure as fertilizer.

In the event that the contents can't be sold, participants in two focus groups agreed with the notion that it could be managed in a manner similar to latrine contents by burying it in a shallow pit. There was only minimal discussion around this point, however, as the initial perception was that this activity (and expense) would not required for the UDDTs.

<u>Agriculture</u>

Land use

Out of 19 participants who reported having available land, 16 of them have cultivated or will cultivate it this year. Availability varied by area, with 6 out of 8 Pamburonko participants having available land and only one Grassfields resident with access to land. While land size data was not collected, focus group discussions revealed that most often the land is quite small.

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[15] Other toilets included pit latrines never emptied(4), hanging toilets(6), pour-flush toilets with an outlet to the waterway(4), and septic tank (1)

Crops Grown
The crops that these respondents stated that they would plant or had already planted included: corn, various plasas (crain-crain, potato leaves, green), cassava, okra, peppers, groundnuts, and rice. Plots used are usually mixed-cropped, a practice where productivity is maximized by filling a space with a variety of different species. While all the growers plan on using the food crops for consumption, 7 also plan on selling small quantities in the local market.

Re-use of Human Manure
The majority (25) of participants were individually supportive of the idea of re-using the contents of the vaults, providing arguments that it would function like animal manure and provide benefits to the soil as well as the plants. Six of these participants also reported witnessing the positive effects of human manure being reused on crops. Of the remaining participants, five were unsure and two believed that human feces should not be used on food crops because of health risks.

When posed to the focus group, however, health risks were not a concern. There were numerous references to the popular onions grown with human manure in Lungi, and one participant even stating, "If you could get sick from eating (vegetables grown with human manure), every Sierra Leonean would already be dead." Apart from the two individuals who had reported health concerns during the individual interviews, the general perception in each group was that as long as the food is washed before eating, there will be no risks.

All of the focus groups reported learning during initial training from Oxfam that the contents of the vaults would be a re-usable manure that could even be sold. Few ideas about who would buy the manure were presented, however, with participants in two groups believing that Oxfam would buy it and then re-sell it to others.

Analysis

The urine-diversion double-vault toilet, through dehydration and storage time, is an effective sanitation technology that reduces the pathogen load of human feces and renders it dry and inoffensive for *safe disposal*. Recommended storage time for human feces before removal is six months and, in more humid climates, a minimum of one year (Rieck C., 2012). For agricultural re-use, however, the dried feces should undergo secondary treatment before application, as resistant intestinal helminths like *ascaris* can persist for extended periods of time in feces as well as soil. According to the most recent WHO guidelines for excreta re-use, effective pathogen die-off through storage should last at least one year, and more recent studies have called into questioned whether even one year is sufficient (Trönnberg L., 2010; World Health Organization, 2006).

The Oxfam UDDT design has two vaults of an estimated capacity of 0.8 cubic meters. As each household member will require an estimated 50 liters of space to ensure six

months of storage, each of these toilets can support a population of 16. Looking at the reported usage of Oxfam UDDTs, however, over half (17) reported total numbers of users that exceeds this amount. If the self-reported data is accurate, these vaults will fill up in less than 6 months time and the storage time will be inadequate for safe disposal. When opened, the feces could potentially be offensive, contain higher amounts of moisture, and have high pathogenic loads.

Dried feces from UDDTs, while not for use in agricultural plots, can be used as a nutrient source for low-risk trees and plants (fruit trees, for example). Recommendation for re-use of dried feces involves burial to a depth of 30cm while remaining 1.5m above the water table. In all five project areas, however, only small pieces of land are available, and the mixed-cropping species reported are of high risk (rice, vegetables, leafy greens). Although thirteen of the participants were interested in planting bananas and other fruit trees where the dried feces could be used, space limitations would make this only a very short-term solution for only a portion of the total beneficiaries.

UDDT beneficiaries are under the impression that not only will there be no cost associated with these toilets. In fact, many believe that the toilets will be a potential source of income as they understand that the vault contents will be sold as fertilizer. This should be of **serious concern**, as sanitation will inevitably require an expense (time or money) and beneficiaries will potentially feel mislead by Oxfam when this is communicated to them. In addition, the majority of the beneficiaries have not had to pay for sanitation in the past, so introducing a cost may be met with resistance. Finally, it should be noted that this perception of income could be playing a large role in the households' reported willingness to empty the vaults on their own.

Lastly, there exists a very low understanding of the health risks associated with human feces. While there is a recognized danger to fresh human manure, reinforced by the cholera education campaigns over the past year, there is an assumption that once it is allowed to "rot" for some time, it is safe to use even on vegetables that are often eaten raw (onions). Unfortunately, this perception may be in large part a result of a very effective but misleading education program at the start of the UDDT project.

Recommendations:

In light of the information gathered during this review and the analysis provided above, the following recommendations are made:

1. Information should be gathered regarding **actual vs. reported usage** of the UDDTs to determine a more accurate estimate of the amount of time it will take to fill the vaults and the resulting retention period.
2. Re-use of the dried feces on agricultural plots in the area is **not recommended.** There remains a high risk for pathogens in the dried feces and local agricultural practices are not "low-risk."

3. Promoting the sale of dried feces, whether immediately from the vault or after storage time in bags, is **not recommended** as there is no control over the safety of this "product" or how the end-user makes use of it.
4. Using biodegradable bags for additional storage of the vault contents is **not recommended.** While additional pathogen die-off would occur through extended storage, this would need to be verified at each household through expensive soil pathogen testing. Even if this could be done, long-term purchasing and procurement of appropriate bags would end up being an additional burden for households.
5. Safe disposal of the dried feces should promoted by encouraging **on-site burial** of the dried feces in shallow pits, where possible. As this is a common practice for emptying local latrines, this would require only a small modification. In comparison to latrines, however, the contents of the vault should be dry, inoffensive, significantly less volume and much safer to handle. While the difficult task of digging a shallow pit in the rocky terrain will still be required, the emptying of the toilets will require only basic protective gear, shovels, and wheelbarrows.
6. While households expressed interest in carrying out the emptying of the vaults, it would be prudent to also **engage local manual emptiers** so they are familiar with the UDDT design and recognize the variety of benefits. This could be done in collaboration with GOAL, who already works with pit emptiers in the area. In the event that households are unwilling to empty the vaults, these pit emptiers can be encouraged to provide this service at a cost much lower than normal latrines.
7. **Proper education** on the risks of handling & reusing human manure should be provided to UDDT households. Care should be taken to distinguish between the high risk associated with "fresh" feces and the significantly lower but still present risk that remains after storage for six months.

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Annex II. GOAL Co-Composting Pilot Recommendations

1. Introduction

Background

In late 2013, GOAL began construction of a pilot co-composting facility as part of their Fecal Sludge Management(FSM) program in Freetown. The aim of this pilot is to test whether co-composting can be a viable alternative to traditional waste treatment options, safely treating wastes while also producing a valuable soil amendment for re-use and even sale. The facility is made up of two main structures; a drying bed for the dewatering of the liquid waste, and a composting structure that will receive the fecal sludge/organic solid waste mix for the composting process.

Objectives

The consultant was asked to review GOAL's co-composting pilot program with the following objectives:

- Determine the availability of organic solid waste materials that could potentially be used for co-composting in Freetown and the Western Area
- Review and provide recommendations regarding GOAL's composting structures and operational plans for the facility
- Identify individuals and/or facilities that have the ability to perform soil analyses for nutrients as well as *ascaris lumbricoides*.
- Explore the issue of short and long-term oversight by government bodies that have waste management mandates.

2. Methodology:

To complete the stated objectives, the following activities were carried out:

- A review of project reports and technical designs used to develop the compost facility
- Site visits with GOAL WASH staff involved in implementing the design
- Meetings and site visits to the compost facility with GOAL's FSM team
- Key informant interviews with local officials and waste management company representatives to identify potential organic waste materials
- Key informant interviews with owners of businesses currently producing quantities of organic solid waste appropriate for co-composting
- Key informant interviews with management staff at local laboratories as well as with officials from the Ministry of Agriculture and the Ministry of Health and Sanitation

3. Results:

3.1. Technical Recommendations for Compost Site

3.1.1. Drying Bed

Made up of as much as 90% liquid, the fecal sludge will undergo a dewatering process at the compost site by placing it first in a drying bed. GOAL has constructed a drying bed with a surface area of 6.25 square meters and a 1 meter deep soak-away pit that is located immediately adjacent. Recommendations regarding the technical aspects of this drying bed are as follows:

Figure 12 GOAL drying bed, May 2013

1. A reinforced-concrete foundation for the drying bed must be installed with a slight slope towards the drainage outlet to ensure that all leachate is being diverted to the adjacent soakaway pit.
2. The drainage outlet needs to be moved to the bottom of the bed and be installed so that the leachate follows the slope of the foundation directly into the outlet.
3. Assuming the recommended hydraulic load of 0.3m is used, that there is a volume reduction of up to 90%, and that drying cycles last up to 15 days, it would take an estimated 36 weeks for the existing drying bed to fill one of the 12.25m^3 constructed compost bins.[16] While recommendations for the pilot include modifications to the composting structure as opposed to the drying bed, future expansion of the site should ensure that the output of the drying beds appropriately correlates with the loading capacity of the compost bins.
4. While the current space does not allow for proper secondary treatment of the leachate, plans to expand the site should include additional treatment methods for this liquid.

3.1.2. Composting Structure:

The compost structure is based on a design developed by SOIL, an organization working in Haiti, with a sloped foundation to facilitate leachate removal while preventing groundwater contamination, a metal roof for moisture control, and empty walls that can be filled with organic materials to insulate the pile while still allowing sufficient aeration.

Figure 13 Compost Bay, May 2013

1. Following on recommendation #3 for the drying bed structure, the constructed compost bins should be partitioned into 1 x 2 meter bins that sit within the existing foundation. With an estimated capacity of 2.4m^3, these bins should be filled after 3 cycles (21-45 days).

[16] A surface area of 50m^2 is needed to fill one of these bins in 2 cycles, or one month

2. The leachate should be channeled to the drying bed soak-away until the larger compost bins are used as designed and leachate can be poured back over the pile.
3. Drainage ditches are needed to protect the site from flooding and erosion during the rainy season. Mitigating the effects of the run-off from the compost structure roof will be of particular importance.

An additional note for the current compost bins is that with a current total capacity of 24.5m^3 and an assumed "holding" time of 2 months before being moved to windrows, the two bins could hypothetically receive 147 cubic meters of mixed organic solid waste (OSW) and dried sludge per year (36.75m^3 of dried sludge, 110.25 of OSW). With an estimated volume reduction of 50% during the composting process, these compost bins could hypothetically produce 73.5m3 of compost each year. What this calculation does not take into account, however, is the large amount of space needed for the drying beds, the secondary treatment of the leachate, and the windrow space necessary for the maturation of the compost after 2 months of holding time.

3.1.3. Hygiene Infrastructure

There is currently no hygiene infrastructure in place at the pilot site. Hygiene and disinfection protocols, which are to be developed by GOAL, will dictate what type of infrastructure needs to be installed. The following recommendations are the bare minimums for a pilot, taking into account the space limitations of the Kingtom site.

1. A hand-washing area with a simple soak-away pit should be installed at the front gate so all individuals exiting/entering the site can wash their hands.
2. A disinfection area and soak-away pit for the washing/disinfecting of tools, boots, and other equipment should be established separate from the handwashing area.
3. Ideally, there should be a clear demarcation between "clean" and "dirty" zones within the site and strict protocols that directs how people and materials can move back and forth between these zones.

3.2. Recommendations for Compost Facility Operations

1. **Hygiene and disinfection protocols** should be developed to minimize any risk of fecal contamination outside of the "dirty zone" of the compost facility as well as to protect all visitors and workers entering/exiting the facility. Ensuring strict adherence to these protocols will be the responsibility of the FSM supervisor.
2. FSM staff and, in particular, staff responsible for operating and maintaining the compost facility should receive basic **hygiene and disinfection trainings** so as to understand as well as adhere to the protocols mentioned in the previous recommendation.

3. The dried fecal sludge and the organic solid waste should be **mixed at a ratio of 1:3** before being loaded into the compost bins. This mixing process can be preformed in wheelbarrows with shovelfuls being the unit of measurement.
4. An **insulating layer** of organic solid material should be placed on all six sides of the pile with a thickness of 6" (15cm) to as to insulate the pile and keep the fecal sludge mixture in the areas where the temperature will be higher.
5. **Temperature monitoring:**
    a. This should happen every 2 to 3 days, starting from the day of the last emptying so as to ensure that the *entire* pile reaches 50'C for at least one week (2006 WHO standard).
    b. A protocol should be developed regarding precise points where temperatures will be taken from each pile on a set schedule. As the temperatures will not be homogenous throughout the pile, representative points in the corners and sides should be included as this is where the temperatures will be lower.
    c. Temperature data should be organized so as to easily track the evolution of the temperatures at different points in the piles and make necessary adjustments (turning, addition of liquid, etc.) to ensure proper treatment.

3.3 Testing

The *safety* and *quality* of the compost that is produced will have a direct effect on who should be targeted as a potential customer group. Determining these two characteristics requires different types of soil analyses; one for nutrients and the other for presence of viable indicator pathogens (*ascaris)*.

- **Nutrient testing**: Soil analyses should be performed to identify the compost's chemical and physical properties; including not only the NPK (nitrogen, phosphorus, potassium) content but also the pH, the amount of organic matter, the amount of soluble salts, and ideally even the levels of other elements that would be found in smaller quantities. As the nutrient levels will not change significantly unless the inputs do as well, nutrient testing is not something that needs to be done regularly.
- **Pathogen testing**: No local laboratory was found that had *experience* testing for *ascaris lumbricoides.* A methodology developed in 2007 in South Africa was shared with identified laboratories and two of these responded that they would be willing to do this testing. It should be noted, however, that the ability to test for *ascaris* ova is more a question of experience in distinguishing between the various ova forms (motile/immotile larva, necrotic, viable undeveloped, etc.) under a microscope than it does any type of obscure equipment or reagents that need to be procured.

- Testing should be done periodically with samples of finished compost product to ensure adherence to the 2006 WHO Standards (< 0 viable *ascaris* ova per Tgs).
- To further increase confidence in the safety of the compost, testing for pathogen *die-off* can be done to ensure the effectiveness of the composting process. This would be done by testing samples in a fresh bin and then continuing to test samples from the same bin at pre-determined intervals in order to determine the die-off curve.

Despite the large role that agriculture plays in the Sierra Leone economy, the options for laboratories to carry out these tests with dependable results are very limited. As a result, the laboratories that were identified quoted prices as high as Le. 75,000 per element for simple nutrient testing and Le. 200,000 per sample for testing for *ascaris* viability. JICA, a Japanese governmental agency that is involved in rice development in Kambia district, opted to send soil samples taken from around the country back to their own laboratories in Japan for dependable results and lower costs. Listen in table 1. below are the laboratories that have been recommended by officials and organizations familiar with soil analyses.

Table 1. Available laboratories

Laboratories	Nutrient Testing	Pathogen Testing	Contact	Email
Njala University	Yes	No	Dr. Peter Musa	petermusa43@yahoo.co.uk
Ramsy House	Yes	Yes	Dr. Alpha Wurie	ramsymedlab@aol.com
SLARI - Rokupr	Yes	Yes	Dr. Dennis Taylor	denrtay@hotmail.com
			Dr. Idriss Baggie	idribaggie@gmail.com

*National Public Health Reference Laboratory in Lakaa did not reply to emails, but may be an option

In terms of costs, both SLARI and Ramsy House estimated that nutrient testing would be priced at Le. 75,000 per element, which for a very simply NPK test on one sample would be Le. 225,000, or over 52 USD. Although Ramsy House stated that a reduced price could be offered depending on regularity of the tests and whether a collaboration would be established with the National Public Health Reference Laboratory, the costs of the nutrient testing would still remain high. For *ascaris*, Ramsy House stated that one sample would cost Le. 200,000, while SLARI could not yet give a specific price for sampling.

3.4 Oversight

3.4.1. Ministry of Health and Sanitation's Environmental Health Department

According to the latest draft of the Sierra Leone Integrated National Waste Management Policy, the government body with direct oversight over waste treatment is the Environmental Health Department (EHD) within the Ministry of

Health and Sanitation. The draft policy states that the EHD is responsible for routine inspections, obtaining samples, and conducting research regarding the operation and maintenance of any waste facility. The EHD is also responsible for providing technical advisory services and setting basic minimum standards for those operating waste treatment facilities.

In practice, however, the EHD does not currently have the technical capacity or the resources necessary to carry out their mandated responsibilities. While the EHD expressed enthusiasm in supporting the program and being integrated in the pilot, there should not be any expectations on the part of GOAL for them to provide significant oversight until there are significant improvements in both the resources available as well as the technical capacity of those within the department. During the pilot, it is recommended that there exist regular communication with the Liquid Waste Management section of the EHD to ensure appropriate protocols are being followed.

3.4.2. Environmental Protection Agency (EPA-SL)

Established by an act of Parliament in 2008, the Environmental Protection Agency is overseen by the President's office and is mandated to coordinate and monitor the implementation all environmental policies as well as ensuring environmentally sound and sustainable development nationwide. In regards to GOAL's compost facility, the EPA requires specific project documents to be submitted in order for them to decide on the necessity for an Environmental Impact Assessment (EIA) is needed for the development. Although the pilot site will likely not require an EIA, future expansion of the site into a larger waste treatment facility will surely require a thorough EIA to be completed and submitted for approval.

3.4.3. Freetown City Council (FCC)

The Freetown City Council, headed by the elected Mayor, will be essential to achieving any success with the pilot project. Although GOAL and the FCC have worked closely together during the project planning stages, it is recommended that GOAL appeal to the Mayor for his support and thereby formalize the collaboration. The FCC can help facilitate communications with the various Ministries and other parties while also helping GOAL follow the necessary protocols as the pilot moves forward and gains the interest of others. It is also recommended that GOAL work to build capacity within Freetown City Council, both to help provide oversight in the future as well as serve as an informed advocate for the project and the technology at the level of the council.

Annex III. List of Soil Amendment Suppliers

Type of Soil Amendment	Estimated Supply
Landfill soil	
Kingtom bome	7 acres available
Granville Brooke	Low supply, no estimates
Palm Kernel Cake	
Marika Palm Kernel	Reported minimum of 18m3 per week
Chicken Manure (50 kg bags)	
Pojah Hatchery	60 bags every 3 weeks
Doray's Poultry	30 bags every 6-8 weeks
Greenfields Farm	20 cubic meters, rate n/a
Hamilton Poultry	unknown
Yele Poultry	20 bags/week down from 100/week
Cow Manure	
Cabalah Cowyard	10 bags/week
Grafton Cowyard	100 bags/week
Pig Manure	unknown (see Bengal Agro)
Compost	
Horticulture Unit	12m3 every 4 months
Fertilizer	
CTC wholesaler	300 tons/year
FAO (Ministry of Ag.)	10,000 50 kg bags/year
Seed Tech	No information provided
Holland Farming	90+ tons/season
King Jimmy Market (2)	(supplier is Holland Farming)
Guard Street Fertilizer	600 50 kg bags/season

Annex IV. List of Potential Customers

Potential Customers	Current Estimated SA Need
Formal Landscapers	
Eskarnn Flowers and Landscaping*	up to 60 m3 per 3 month contract
Oleandor Gardening and Ag Services*	up to 450kg per month
Joseph Lamboi	up to 20m3 per contract
Mrs. Gooding*	varies widely, ~50 bags/month
Informal Landscapers	
Jacob*	60 bags/month in-season
Matthew*	up to 20 m3/contract
Prince*	90 bags/month in-season
Florists (denoted by * above)	
Awuna Florists	20 bags every 3 months
Mining Companies	
African Minerals	12 hectares in 2012
Sierra Rutile	150 hectares per year
London Mining	unknown
Hotels	
Bintumani Hotel	None
Mammyoko-Radisson	14 acres of turf establishment
Country Lodge	50 bags/year
Family Kingdom	200 USD/year
Real Estate Co.	
Regimanuel Grey	15 acre in 1 of 4 current developments
Guoji Property Development Co. Ltd.	6500m2 in 1 of 3 current developments
Urban-Peri Urban Agriculture	1400+ farmers
Large-Scale Agriculture Companies	
Complant Magbass Sugarcane	4000 acres of sugarcane plantation
Bengal Agro	6m3 per acre, up to 18,000 acres
Golf Club	
Freetown Golf Club	~38m3 for18 green "belts"

Annex V. Oxfam UDDT Survey Tools

Participant Interview

A. Personal Information

1. Name: _____ 1.1 Sex: [Male] [Female]

2. Age: [ ]

3. How many people in your family use the EcoSan toilet? [ ]

4. Which community: [Robiss] [Mayenkineh] [Tonda Hill] [Pamburonko] [Grassfields]

5. How long have you lived in your current house? [< 1 year] [1-2 years] [3-5 years] [> 5 years]

6. The house where you live, is it: [Rented] [Owned] [Willed] [Other:]

7. What religion do you practice? [Muslim] [Christian] [None] [Other:]

B. UPA Agriculture

8. Do you have land that you can plant on? [Yes, Q10] [No]

9. If not, do you have any neighbors who do plant? [Yes] [No]

10. Will you plant, or have you already planted, food crops on your land this year? [Yes] [No]

10.1. If so, what are they? _____

10.2. Do you sell these crops or does your family eat them? [Sell] [Consume] [Both]

11. Would you like to plant fruit trees on your land? [Yes] [No]

If not, why not? _____

C. UDDT Information

12. How many families use your EcoSan toilet? [ ] How many people in total? [ ]

13. What do you put in the toilet to cover the feces? _____

14. Where do you find this? _____

15. What else can be used as cover material? _____

16. Have you ever had a toilet in the past? [Yes] [No]

16.1 What kind was it? [pit latrine] [hanging] [pour-flush to waterway] [other:]

16.2. If pit latrine, have you ever paid to have it emptied? [Yes] [No]

16.3. How much did it cost to empty it? [ ]

19. Do you think the human manure from **your toilet** should be used for planting trees or crops?

[Yes] [No] Why or why not? _____

UDDT Household Members
Focus Group Discussion Outline

1. Can you tell me how these toilets are different from pit latrines?
    a. Explore reason for separation, benefits to user, and eventually what is known about the contents of the vault

2. Would you rather have this type of toilet or a normal latrine? Why?

3. What happens in your community when a latrine is full? How do you deal with it?

4. What do you think should happen when the EcoSan toilets are full and need to be emptied?

5. What do you think of using animal manure on food crops? What about human manure?

6. Would you have any concerns about eating vegetables grown in compost made with human manure?

Annex VI. UPA Survey Tools

UPA Farmer Interview

April-May 2013

A. Personal Information

1. Name of farmer: _____ 1.1 Sex | Male | Female

2. What religion do you practice | Christian | Muslim | None | Other

3. Are you part of an association or cooperative? | Yes | No

4. If so, what is the name of it? _____

B. Agricultural Practices and Fertilizer

5. How long have you been farming? | <1 years | 1-5 years | 6-10 years | > 10 years

6. Who owns the land that you farm? | Self | Private | Government | Other:

7. How did you aquire the land? | Bought | Willed | Leased | Rent | Other:

7.1. If you pay for access, how much do you pay each year? _____

8. How big is the land that you grow on? (acres, heaps, bushels, etc.) _____

9. What crops do you grow? _____

10. Do you use fertilizer? | Yes | No, Q13

11. If yes, what type? | 15-15-15 | Urea | _____ | _____

12. How much of these did you use last year? (see chart below)

13. How much each of these cost (per unit)?

	2012	Cost per unit (Le.)
15-15 cup		
15-15 25 kg		
15-15 50kg		
Urea cup		
Urea 25kg		
Urea 50 kg		

15. Would you have wanted to purchase more fertilizer last year? | Enough | Wanted More

16. Where do you buy this fertilizer? _____

16. How much to transport one bag of fertilizer from there? _____

C. Manure and Compost

16. Do you use animal manure on your land? Yes / No

16.1. If so, what types? Poultry / Pig / Cow / Goat / Sheep

16.2.How do you get this? Buy (16.3) / Own animals / Other:

16.3. How many bags used last year? (see chart below)

16.4 What did each of these bags cost? (see chart below)

	Bucket	25 kg	50 kg	"Kilo"	Other	Unit Cost, Le.
Chicken						
Pig						

17. Was this enough or would you have liked to purchase more? Enough / Wanted More

18. Do you use compost on your land? Yes / No

18.1. If yes, how did you get it? Self prepared / Bought / Collect from somewhere

Other:

19. How did you learn or were taught about new farming practices?

- ☐ Farmer field schools
- ☐ Association/Coop
- ☐ Extension Services
- ☐ Radio
- ☐ Neighbors
- ☐ Family
- ☐ Others:

UPA Farmers
Focus Group Discussion Outline

1. How do you apply these?
    a. Fertilizer
    b. Chicken Manure
    c. Household manure
    d. Bome Soil
    e. Others

2. Can you tell me what you know about compost?

3. Of all these (compost, bome, fertilizer, etc.) which is better? Why?

4. What do you think of compost made from human manure?

5. Would you like to use it on your crops? Why?

6. How much are you willing to pay for this compost?

7. Would you be willing to test this compost on your crops next season?

Annex VII. List of Interviewees

Institution	Name	Position	Phone/Email
Key Stakeholders			
Freetown WASH Consortium	Maria Dillon	CCU Coordinator	mdillon@oxfam.org.uk
Oxfam	Chris Playford	WASH Manager	cplayford@oxfam.org.uk
Oxfam	Muhamed Kallon	HP - Monitoring and Evaluation	mkallon@oxfam.org.uk
Oxfam	Aime Kayinamura	Partnerships Coordinator	AKayinamura@oxfam.org.uk
Oxfam	Abie Murray	Hygiene Promotion	Amurray@oxfam.org.uk
Oxfam	Abubakarr Wurie	PH Engineering Team Leader	AWurie@oxfam.org.uk
Adam Smith International	Will Tillett	WASH Facility Manager	will.tillet@adamsmithinternational.com
Freetown City Council	Abdul Karim Marah	Development Officer, Liasion for CCU	marahabdulkarim@yahoo.com / marah_abdulkarim@yahoo.com
Government Officials			
Ministry of Agriculture	Dr. Pamela Konneh	FUPAP Coordinator	pamelakonneh@yahoo.com
Ministry of Agriculture	Phoebian Fofana	Western Area Coordinator	033-350-634
Ministry of Agriculture	Daniel Yambasu	Block Extension Officer - Western Rural	088-513-450
Ministry of Agriculture	Stephen Young	Block Extension Officer - Mountain	076-772-802
Ministry of Agriculture	Fanel	Block Extension Officer - Western Urban	076-948-383
Ministry of Agriculture*	Joseph Lamboi	Horticulture Unit - Head Instructor	076-549-365
Ministry of Agriculture	Ivan Dixie	Depot Controller	076-606-609
Environmental Protection Agency (SL)	Momodou Bah	Deputy Assistant Director	078-350-627
Min. of Health & Sanitation - Env. Health	Mr. Chas	Waste Management	076-662-547
Min. of Health & Sanitation - Env. Health	Saffa Saidu	Intl. Vector Management Coordinator	saffasaidu@yahoo.com
Min. of Health & Sanitation - Env. Health	Sallu Dean	CLTS Coordinator	salludeen2007@yahoo.com
Min. of Health & Sanitation - Env. Health	Mansura Boh	Assistant Manager	076-780-376

Freetown Waste Management Company	Sulaiman Parker	Environmental Health Officer	suzaipark@yahoo.com/ parkersulaiman@yahoo.com
SL Agricultural Research Institute	Dr. Idriss Baggie	Soil Scientisti	idribaggie@gmail.com
SL Agricultural Research Institute/Njala University	Dr. Peter Musa	Vegetable Expert	petermusa43@yahoo.co.uk
Other National Institutions			
Fourah Bay College	Kabba Bangura	Researcher, Geography Department	ksbangura@yahoo.com
Fourah Bay College	Jinnah Momoh	Lecturer, Geography Department	jsmomoh2000@yahoo.ca
National Association for Farmers of Sierra Leone	Mohammed Kabiru	Secretary to the President	076-675-263
National Association for Farmers of Sierra Leone	Mr. Olu John	President	N/A
International Institutions			
Japanese International Cooperation Agency	Takashi Kimijima	Project Chief Advisor	kimijima@recs-intl.co.jp
United Nations Food and Agriculture Organization	Joseph Brima	Senior Programme Advisor	Joseph.Brima@fao.org
UK-Department for International Development	Martin Walshe	Senior Regional Infrastructure Advisor	m-walshe@dfid.gov.uk
UK-Department for International Development	Keith Thompson	Private Sector Development Advisor	k-thompson@dfid.gov.uk
Welthungerhilfe	Jochen Moninger	Project Manager, WAPFR	Jochen.Moninger@welthungerhilfe.de
Welthungerhilfe	Frank	Livelihoods Coordinator	078-939-778
OSW Suppliers			
Sierra Leone Brewery Ltd (Heineken)	Mr. Alieu Kafoe	Total Quality and Product Manager	Alieu.kafoe@heineken.com
Prince's Workshop	Prince	Owner	033-894-168
Amtech Agencies	Mahmoud Kadi	Manager	amtechsl@yahoo.com
Poultry Farms			
Pajah @ I.J. (SL) Ltd Hatchery	Habib Pajah	Owner	habibpajah@hotmail.com
Greenfield Farm	Mr. Sidi	Part-Owner	077-602-011
Yele Poultry	H R Mansaray	Manager	amaramomoh@yahoo.com
Doray's Poultry	Mr. Claude	Owner	076-622-545
Hamilton	Mr. Alfred	Owner	077-328-522
Fertilizer Suppliers			

Seed Tech International	Mohamed A. Bahsoon	Managing Director	seedtechint@yahoo.com
CTC	Ahmad D. Fakhoury	(N/A)	ahmadfakhoury@ctc.sl
King Jimmy Market	Memunah Bangura	Merchant	077-491-944
King Jimmy Market	Ms Kamara	Merchant	n/a
Holland Farming	David Sallu	Owner	076-820-888
Guard Street	Fatmata Sesay	Owner	076-908-253
Other Soil Amendment Suppliers			
Marika Palm Kernel Oil	Said Koroma	Owner	marikaenterprises@yahoo.com
Kingtom Bome excavator	Saidu	Head organizer	078-810-139
Krissy Road bome excavator	Mr. Koroma	FWMC representative	077-263-883
Eastern Cow Yard	Unknown	N/A	N/A
Landscapers* and Florists ^			
Eskarnn Flower and Landscaping Design*^	Mrs. MacAuley	Owner	033-371-641
Eleandor Gardening and Ag Services*^	Pierre Dauphin	Owner	078-710-893
Matthew's Nursery*^	Matthew	Owner	076-751-065
Prince's Nursery*^	Prince	Owner	088-937-392
Jacob's Nursery*^	Jacob	Owner	030-816-300
Mrs. Gooding*^	Mrs. Gooding	Owner	076-660-212
Awuna Florists^	Ore A. Renner	Owner, master florist	076-613-167
Large Agriculture Companies			
COMPLANT Magbass Sugar Company	Matthew Li	Representative	Liteng1987@gmail.com
Bengal Agro SL Ltd	Md Shah Alam	Country Director	shahalam_b57@yahoo.com
Addax Bioenergy	Yves Ricaud	Distillery Manager	Yves.Ricaud@addaxbioenergy.com
Shankerdas & Sons	Mr. Suresh	Part-owner	sureshbhagchandani@yahoo.com
Golf Clubs			
Freetown Golf Club	Mohamed	Head Gardener	n/a
Freetown Golf Club	Mr. Paul	Golf Pro	076-865-824
Freetown Golf Club	Mr. Alpha	Elected Manager	076-626-810
Construction Companies			
NIMO	Afriyie Assamany	Managing Director	a.assamany@nimoconstructionltd.com
TEDA	Gibril Koroma	Architect-Managing Partner	gibrilfkoroma@yahoo.com
ICC	Mr. Basmah	Owner	076-602-258

JYGA	Manilius Garber	MSLIA, AAAB, FICMP	maniliusgarber@jyga-architects.com
Realini Bader Associates Ltd	I. N. Yilla	Managing Director	rbalini@homal.com
Real Estate Companies			
Guoji Property Development Company Ltd.	Anthony Jimmy	Administrative Officer	guojiproperty@gmail.com
Guoji - West African Sunshine	Corlon	Head Gardener	n/a
Guoji - West African Sunshine	Ibrahim	Gardener	n/a
VSL Properties	N/A	Administrative Assistant	079-004-004
Hotels			
Country Lodge	Eddy	Head Gardener	078-327-474
Radisson	Jean-Francois Remy	General Manager	jean-francois.remy@radissonblu.com
Radisson	Mohamed	Head Gardener	n/a
Family Kingdom	David	Head Gardener	n/a
Bintumani Hotel	Mrs. Thompson	Deputy Assistant Manager	076-748-407
Bintumani Hotel	Joseph	Gardener	n/a
Mining Companies			
Sierra Rutile	Mr. Ansu Jabati	Environmental Officer	ajabati@sierra-rutile.com
London Mining	Beran Forster	Environmental Officer	beran.forster@londonminingsl.com
African Minerals	Daphne Awuta-Coker	Environmental Program Superintendent	daphne.awuta-coker@african-minerals.com
Laboratories			
Ramsy Med Lab	Alpha Wurie	Doctor, Owner	ramsymedlab@aol.com
SLARI - Rokpur	Dr. Dennis Taylor	Pathology Researcher	denrtay@hotmail.com