

COMMUNITY PERCEPTIONS TOWARDS COMPOSITING OF MUNICIPAL SOLID
WASTE IN EWUATA VILLAGE, ERUBA PARISH, VURA SUBCOUNTY IN ARUA
DISTRICT

A thesis

Presented to the School of
Post graduate Studies and Research
Kampala International University
Kampala, Uganda

In partial Fulfilment of the Requirement for the degree
Master of Science in Environmental management and Development

TD7945
A484
2010



By

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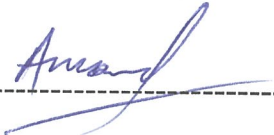


PG-76400

September 2010

Declaration

I, **Amandua Ecebo Joseph**, do hereby declare that my thesis titled "*Community perceptions towards compositing of municipal solid waste in Ewuata village, Eruba parish, Vura subcounty in Arua district*" is entirely my own original work, except where acknowledged, and that it has not been submitted before to any other University or institution of higher learning for the award of a degree.

Signed: -----


Date: 17/09/2010-----

This thesis has been submitted for examination with my approval as the candidate's University supervisor.

Signed: -----

Date: 20/09/2010-----

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Signed: -----

Date: 25/09/2010-----

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Dedication

This work is dedicated to my children Nicole Letasi Amaniyo, Alban Norman Mungufeni and Ann Asianzu Naomi who dearly missed me during the two years period of my study.

Acknowledgement

Special thanks go to my supervisors Mr. Kassim Sekabira and Dr. Ssegawa Paul for their guidance throughout the research process and their course units of solid waste management and environmental health respectively that inspired me to do this research. I am grateful to my dear wife Deboru Florence for her moral and financial support and taking proper care of the family when I was away for my studies. I am also thankful to Ofezu Godfrey for literature review materials he sent me from USA, Kissa David Ocama for encouraging me to enrol for masters' course and Ishimo Yvette for proof reading my proposal, the prayer support and encouragement during proposal development. I'm deeply indebted to all of you for the various support, may the almighty God reward you abundantly.

TABLE OF CONTENTS

Declaration	ii
Dedication	iii
Acknowledgement.....	iv
TABLE OF CONTENTS.....	v
List of tables	vii
List of figures.....	viii
ABSTRACT	ix
CHAPTER ONE: INTRODUCTION	1
1.1 Background	1
1.2 Problem statement.....	1
1.3 Purpose of the study	3
1.4 Research objectives	3
1.5 Research questions	3
1.6 Scope.....	3
1.7 Significance of the study.....	4
CHAPTER TWO: LITERATURE REVIEW	5
2.1 General overview about solid waste management	5
2.2 Composting as a waste management strategy and use of compost in agriculture.....	6
2.3 The need for community participation and involvement in composting	8
2.4 Importance of community awareness in municipal solid waste composting .	9
CHAPTER THREE: MATERIALS AND METHODS	11
3.1 The study area.....	11
3.2 Research design.....	12

3.3 Sampling method and sample size	12
3.4 Data collection	13
3.5 Data analysis	13
CHAPTER FOUR: RESULTS AND DISCUSSION	15
4.1 Personal information	15
4.2 Awareness on composting and compost use (objective one).....	15
4.3 Recipient community willingness to compost municipal solid waste (objective two).....	17
4.4 Feasibility of municipal solid waste composting in recipient communities (objective three).....	23
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS	26
5.1 Conclusion.....	26
5.2 Recommendations.....	27
REFERENCES	28
APPENDICES.....	32
APPENDIX A: QUESTIONNAIRE	32
APPENDIX B: RAW DATA.....	36

ABSTRACT

Rapid growth of businesses and population in and around Arua town has led to increased production of solid waste consequently giving rise to increased volume of waste dumped in recipient communities. The most attractive and environmentally friendly option to get rid of this huge pileup of garbage and subsequent ones is through composting. The perceptions of recipient communities are crucial to understanding how municipal solid waste management problems might be resolved. Since Arua municipality still uses open dumping system of waste management, there is need to compost this waste to reduce its volume and at the same time to provide compost and other benefits associated with composting to the community. The perceptions of communities in the dumping areas (recipient communities) are likely to influence the start-up and performance of such initiative. This study provides insights on how recipient community perceptions affect composting of municipal solid waste in the dumping areas of Arua district. A structured questionnaire survey was implemented in order to interview local residents in the dumping area. The results showed that imparting municipal solid waste composting knowledge to recipient communities enhances increased participation and hence the amount of waste composted. The general perception is that people are willing to compost if there are some prior benefits or incentives given to them; otherwise it is feasible to compost in recipient communities. Therefore any composting scheme introduced in the recipient communities of Arua must be accompanied by direct incentives from the government or NGOs to motivate the people and at the same time to mitigate some of the hindrances/constraints to composting.

CHAPTER ONE

INTRODUCTION

1.1 Background

Arua municipality still uses open dumping system of waste management and hence there is need to compost this waste to reduce its volume and at the same time to provide compost and other benefits associated with composting to the community. Community perceptions are critical in understanding how to resolve issues surrounding waste management in general and composting in particular. Therefore, composting of municipal solid waste especially in dumping (recipient) communities will be crucial and desired in the efforts to save the deteriorating environment and to increase crop production through use of compost. To achieve this, the perceptions of the recipient communities towards composting of this waste needs to be assessed.

This study therefore intends to provide insights on how recipient community perceptions affect composting of municipal solid waste in the dumping areas of Arua district. The second section of this study reviews previous studies on compost use, community participation, perceptions and awareness towards composting of municipal solid waste. The third section describes this study's research methods and materials used. Findings and discussions are presented in the fourth section, which includes; level of awareness on composting and compost use, willingness to compost municipal solid waste as well as feasibility of municipal solid waste composting, the best ways to encourage composting and responsibility of some stakeholders. The final section provides conclusion and recommendations of this research.

1.2 Problem statement

The rate at which solid waste is generated in urban areas has steadily increased over the years (Pokhrel and Viraraghavan, 2005) and this growth has not been accompanied by an equivalent increase in capacity of the relevant urban

authorities for managing these wastes (NEMA, 2000). Consequently, many fringing peri-urban communities heavily suffer the burden of waste disposal in their areas. The composting of such waste in those communities nevertheless could help to turn the problem into an opportunity as it would provide manure, recycling and reuse, employment and other benefits to the local people.



Fig. 1: Scene of Arua municipality open dumping site at Ewuata.

Businesses and population in Arua town are growing rapidly and consequently there is a rapid increase in solid waste production putting pressure on already strained collection and disposal systems. As a result, dumping (recipient) communities of Ewuata village are receiving extensive amounts of municipal solid waste (Fig. 1) but very little is known as to the environmental and health consequences of this. Farrell and Jones, (2009); Ibrahim, (2008) advocate for composting as attractive waste management options to get rid of huge piles of wastes. Because of the huge garbage pileups in the recipient communities in Arua district and the likely environmental and health impacts coupled with deteriorating soil fertility, it is imperative to investigate potential perceptions of local communities surrounding the dumping site towards composting of these wastes. Consequently this study aims to find out how perceptions of recipient communities

of municipal solid waste affect its composting in relation to future initiatives to compost municipal solid waste in such communities.

1.3 Purpose of the study

The purpose of this study was to find out how perceptions of recipient communities of municipal solid waste affect its composting in such areas. This could help the government and other development partners to turn the waste problems in those communities into opportunities for their wellbeing.

1.4 Research objectives

1. To assess composting awareness and compost use in recipient communities.
2. To determine recipient community willingness to compost municipal solid waste.
3. To examine the feasibility of municipal solid waste composting in recipient communities.

1.5 Research questions

1. What is the level of composting awareness and compost use in recipient communities?
2. How willing are recipient communities in composting municipal solid waste?
3. How feasible is it to compost municipal solid waste in recipient communities?

1.6 Scope

The study was carried out in Ewuata village of Eruba parish in Vura subcounty, 7km from Arua town where the waste is being generated. This is the current garbage dumping site for Arua municipality. This study covered recipient community awareness on composting and compost use, willingness to compost, and feasibility of composting municipal solid waste in the area.

1.7 Significance of the study

As community perception is an important part of composting, and perception related to composting in Arua district has not been extensively investigated, this study will aim to contribute baseline data on recipient community perceptions related to composting in the district. The findings of this study will benefit Arua municipal council as waste management authority in formulating policies aimed at promoting composting as a sustainable waste management strategy. Nongovernmental organisations (NGOs) and other development agencies interested in promoting municipal solid waste composting will also find it useful as a starting point.

CHAPTER TWO

LITERATURE REVIEW

2.1 General overview about solid waste management

Solid waste management comprises a diverse range of activities encompassing reduction, recycling, segregation (separation), modification, treatment and disposal at varying levels of sophistication (Hamer, 2003). The technological solutions to deal with municipal solid waste management must satisfy the sanitary and environmental purposes and also those related to the economic and social aspects (Magrinho *et al*, 2006). The environmentally acceptable management of municipal solid waste has become a global challenge due to limited resources, ever increasing population, rapid urbanization and industrialization worldwide (Pokhrel and Viraraghavan, 2005). Wise and sound management of garbage involves participation of each agency or person concerned with segregation at source, proper collection, transportation and environmentally safe disposal, besides recycling and reuses (Kuniyal *et al*, 1998).

Technically, the composition of the solid waste is an important consideration in deciding on the type of disposal method to adopt for a particular community (Pokhrel and Viraraghavan, 2005). The various strategies available for solid waste management must be considered as a hierarchy of opportunities with waste reduction at source as the best option (Hamer, 2003). The strategies that can be adopted for integrated solid waste management are to: reduce the amount of solid waste generated, recycle as much refuse as possible, incinerate or change to compost the waste with appropriate environmental controls and with energy recovery options and to continue sanitary land filling for selected waste items (Ambat and Saharsh, 2003).

2.2 Composting as a waste management strategy and use of compost in agriculture

There is need to support measures that can address urban waste and agricultural needs simultaneously and use of urban organic wastes, particularly municipal solid waste should be acknowledged within discussions of solid waste management and the role of farmers recognised and understood (Nunan, 2000). Composting of the solid waste and using the compost as an organic fertilizer is a sustainable way of managing solid wastes if a large fraction of the waste is organic in nature (Pokhrel and Viraraghavan, 2005). With municipal solid waste streams comprised of 55% or greater organic matter in developing countries, composting is being considered in many parts of the world (especially in the tourist and agricultural sectors) as a method to reduce waste destined for the landfill (Troschinetz and Mihelcic, 2009). The opportunities for land filling as a disposal method for municipal solid waste (MSW) are rapidly declining with depleting available cheap land resources and the wasteful nature of disposing useful resources in the landfill operation (Mckay, 2002). Finding safe, sustainable and cost-effective alternatives to the disposal of municipal solid waste in landfills represents a major challenge to the waste management industry (Farrell and Jones, 2009). Recycling and composting are hence seen as attractive waste management options to get rid of huge piles of wastes, providing that there are few negative effects on the environment (Farrell and Jones, 2009; Ibrahimi, 2008). The selective collection and the recycling of biosolids and the organic fraction of the municipal solid waste are essential factors for the success of a modern policy of global management of municipal solid waste and therefore, the composting process, whose ecological and economic advantages are evident, plays and must play an essential role in the global management of domestic waste (Domingo and Nadal, 2009). The growing recognition of the role of urban and peri-urban agriculture in providing food for local markets, creating employment and soaking up urban organic wastes may provide the impetus for such an integration of policy objectives (Nunan, 2000).

The composting process is currently viewed primarily as a waste management method to stabilize organic waste, such as manure, yard trimmings, municipal

biosolids, and organic urban wastes (EPA, 1998). Composting refers to biological degradation or break down of organic matter such as leaves, grass, clippings, cardboard, paper etc under aerobic conditions (Cunningham, 2002; Chiras, 1994) to carbondioxide, water and stabilized residue, principally humic substances called 'compost' (Bradshaw *et al*, 1992). The resulting organic compost makes a nutrient-rich soil amendment that aids water retention, slows soil erosion and improves crop yields (Cunningham, 2000; Hamer, 2003). Yard waste constitutes a significant percentage of municipal solid waste and therefore can be decomposed in backyard compost bins and used in gardens and flower beds (Buchholz, 1993).



Fig. 2: Older section of Arua municipality dumping site showing potential of decomposed municipal solid waste to boost plant growth.

From the above definitions, it is evident that composting is decomposition of organic materials to produce manure which can be used for improvement of soil fertility to boost plant growth as shown in Fig. 2 for increased crop production. The nutritive value of municipal solid waste composts and their potential to enhance soil quality makes them ideal for agriculture, provided that correct precautions are taken to mitigate against environmental damage and to gain public acceptance (Farrel and Jones, 2009). Composting of municipal solid waste has potential as a beneficial recycling tool and its safe use in agriculture, however,

depends on the production of good quality compost, specifically, compost that is mature and sufficiently low in metals and salt content (Hargreaves *et al*, 2008). The identification of the most suitable conditions for composting will allow the implementation of this alternative remedy to reduce waste and tackle the problem in waste management, particularly in developing countries (Fauziah and Agamuthu, 2009).

2.3 The need for community participation and involvement in composting

Community participation is the process by which individuals and families understand responsibility for their own health and welfare of societies (Singh *et al*, 2007). In judging performance in source-separation recycling schemes focus has most often been on participation; on why people do or don't participate, and on their motivation and attitudes towards recycling and other environmental issues (Thomas, 2001). Over the past decade, there were many studies on public involvement/participation to help facilitate the management of natural resources, environmental quality, as well as the customization of sustainable development modes (Cai *et al*, 2009). Community-based initiatives and involvement are becoming more and more popular as one of the solutions to achieving sustainable development (SOSC, 2006). The quality of life of some communities has been deeply impacted by historical events and decisions hence community members may have strong feelings about past decisions on land use and it is therefore critical to gain an understanding of these issues from the community's standpoint (EPA, 2000).

The improper management of household waste is linked to the systematic failure of policy makers and municipal authorities to identify the most sustainable ways of dealing with it in such a manner that is in line with socio-economic aspirations and negligence of the impact of public attitudes and behaviour (Mbeng *et al*, 2009). Households' solid waste management in the cities of developing countries is yet to be recognized as a well organized programme (Chakrabarti *et al*, 2009). An

integrated approach to deliver urban services is increasingly being proposed as a possible solution to the waste management problem (Ahmed and Ali, 2004) and community participation along with waste management authority in the field of solid waste management is one of the most frequently suggested methods (Zia and Devadas, 2007). Thus the need to get community perception on any solid waste management strategy is very crucial.

Community involvement helps in marketing where compost produced is sold at the neighbourhood, whereby marketing strategies are limited to mouth-to-mouth information by core members of the association (Zurbrug *et al*, 2002). Economic viability of composting is possible when installation costs, capital costs, land and labour costs are low which is the case with community based schemes (Binner and Linzner, 2009). The community participation is needed to improve the quality of compost by involving in point or source separation programs (Basnayake, 2001; Hargreaves *et al*, 2008). The level of participation in a scheme is obviously critical to success; however it is not just how many people participate but how well they do so, how effectively they participate, that is an important parameter (Thomas, 2001).

2.4 Importance of community awareness in municipal solid waste composting

Acceptance of composting is not guaranteed, with the most negative responses being a lack of knowledge or awareness, or the perception that it is too much effort (Price, 2001). As the success of any programme depends greatly on public acceptance, the communities and the people concerned should be made aware about the programs, the processes, advantages and the disadvantages (Ambat and Saharsh, 2003). For the introduction of any management method, the necessary conditions are people's awareness regarding the method as well as their willingness to cooperate with the authority, both physically and financially, in conducting such a programme (Chakrabarti *et al*, 2009). Community should be made aware of health risks associated with improper solid waste management

unlike in the past where there have been no major efforts to create community awareness for citizens, which is a vital component of solid waste management system (Singh *et al*, 2007).

Knowing what and how well people understand how to participate in a scheme and what they choose to do about it is invaluable evidence for local authorities in identifying where and how to target public information campaigns and effectively improve quality of participation, and hence the quantity of material diverted cost effectively (Ambat and Saharsh, 2003). The community participation can be strengthened through multidisciplinary nature of Information, Education and Communication for the citizens (Singh *et al*, 2007). Education is needed to maintain community participation to establish a 'spirit of responsibility' towards environmental problems and the most suitable ways of dealing with them (Ambat and Saharsh, 2003). Consulting and training activities on sustainable waste management targeting local communities and specific target groups should become a priority in order to support related initiatives (Zotos *et al*, 2009).

CHAPTER THREE

MATERIALS AND METHODS

3.1 The study area

The study area is Ewuata village of Eruba parish in Vura subcounty, Arua district. This is a peri-urban area located 7km from Arua town. Arua district is located 520km north west of Kampala the capital of Uganda as shown in Figure 3. The district covers a total area of 3,112.85 Km² and is between latitude 2⁰ 30'N and 3⁰ 50'N and longitude 30⁰ 30'E and 31⁰ 30'E in the North Western part of Uganda.

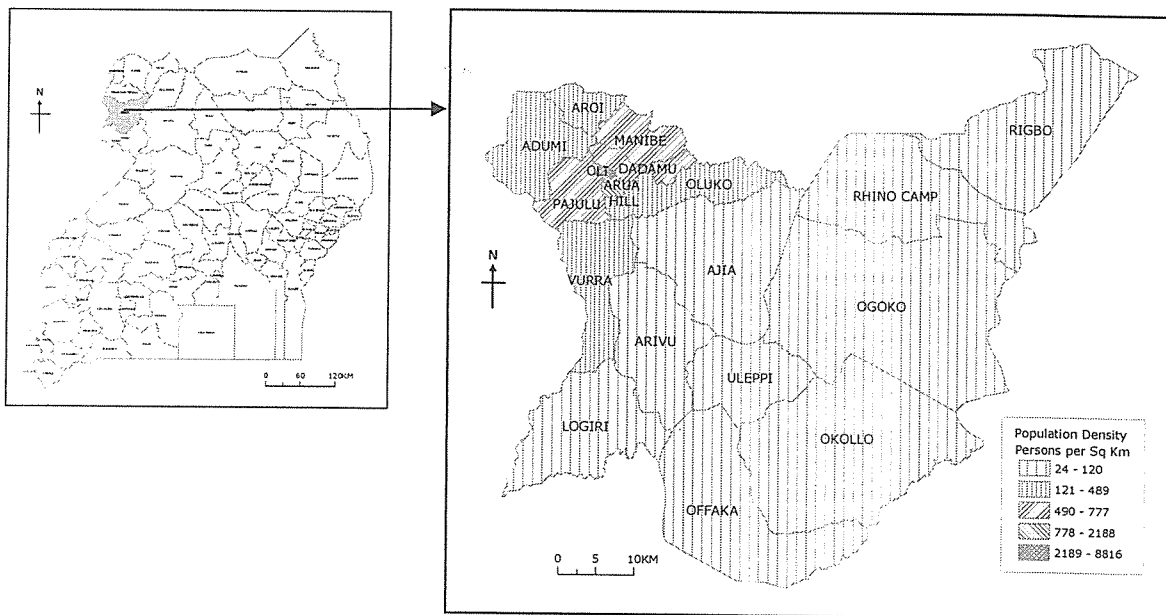


Fig. 3: Location of Arua district and the population densities of the different communities in the district

In Arua town, population growth and economic expansion have exerted great pressure on the environment. Recently, the increasing economic development in and around Arua municipality has given rise to a series of potential threats to the deteriorating environment in terms of increased solid waste generation.

3.2 Research design

Structured questionnaire survey was used to collect data by interviewing respondents from Ewuata village in Eruba parish whom the local authorities have registered as residents. Simple random sampling of households was conducted from household lists obtained from the local authorities. The questionnaire was pre-tested and subsequently modified with the following attributes included in the final copy:

- Personal information which included gender and age;
- Awareness on composting such as hearing about composting and the source of information, compost use and knowledge and benefits of composting;
- Willingness to compost municipal solid waste;
- Feasibility of municipal solid waste composting.

3.3 Sampling method and sample size

A simple random sampling method was used to select households from the list provided by the local authorities of the area as described in 3.2 above. The survey was administered to 150 respondents (in 150 households), with 68 males and 82 females. The size of the sample was determined by using the formula applicable to estimating sample size (EDA Rural Systems Pvt Ltd; 2006) as shown below.

$$N = \frac{Z^2 \times P \times (1-P) \times D}{E^2}$$

Where,

N = Estimated minimum sample size;

Z = Z value (or Z-score) from the anticipated confidence level;

P = Anticipated proportion that is to be measured;

D = Design effect;

E = Precision (or margin of error).

For this study the following values were considered:

Confidence level = 95%

Z- Score = 1.96

P = 40%

D = 1.5 (recommended for random sampling).

E = 10%

This gives N = 138.

At 90% repose rate, final N = $138/0.9 = 153$, rounded off to **150**.

3.4 Data collection

Prior visit to study area and contact with the local leaders were the base to establish a link with the local authorities for introduction of the subject and establish possibility for carrying out the questionnaire survey. Questionnaires were administered to the respondents with immediate collection of data. This was considered appropriate for two main reasons. In the first instance, to take care of the low levels of literacy in the community which could make them not read and understand the questionnaire. Secondly, to track down the respondents so that they could easily respond to the questionnaires on spot to save time and improve response rates.

Open ended responses were recorded so as not to constrain responses and to allow a more nuanced array of responses. This was particularly important to understand respondent's views on the best ways to encourage composting in the community. These were later summarised and presented as in figure 6. Interviews were conducted in the language the respondent understood best to overcome language barriers. Respondents were approached either in their homes or while carrying out their occupation. All respondents were residents of the local community surrounding the dumping site.

3.5 Data analysis

Descriptive statistics was used to summarise data. The survey questionnaires were organised using Ms Excel. Data was coded and entered into Ms Excel to generate frequencies and percentages using pivot table. Tables and bar graphs were used

to display the results. The data from household surveys was analysed using the statistical package for social sciences (SPSS) version 16.0. Spearman rank order correlation statistic (r_s) was used to measure relationships between variables with a value of less than 0.05 and 0.01 considered significant.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Personal information

Out of the 150 respondents, 45% were males while 55% were females. Most of the respondents were aged between 20-44 years.

4.2 Awareness on composting and compost use (objective one).

In the context used in this study, awareness on composting and compost use refers to knowledge and perception of composting initiatives and the feeling about such initiatives that could influence one to participate or not to participate. This was assessed through hearing about composting and the source of the information, sight of and number of people using compost in the community, knowledge on composting, environmental and other benefits of composting.

Most respondents (92%) heard about composting and only 8% never heard about it. The source of the information was mainly through government officials, colleagues and the media (32%, 29% and 27%) respectively. This could be attributed to the fact that majority of the respondents are in the active age group (20-44) where they must have heard through active interaction with peers or learnt from agriculture lessons in schools which is part of the curriculum right from primary level. Apart from that, they could have heard from the local FM radio stations in the region.

Majority of the respondents (95%) have seen people using compost in gardens elsewhere but few people use it in this community. These results showed that recipient communities are generally aware of composting and compost use but this awareness does not necessarily translate into practising composting. Failure to translate awareness into practising composting could limit the success of public awareness programmes intended to promote municipal solid waste composting.

Table 1: Spearman's Correlation coefficient (r_s) of variables on awareness and composting of municipal solid waste (n=150).

	HAC	NPC	KOC	RAW
HAC	1.000			
NPC	0.667	1.000		
KOC	0.500	0.975**	1.000	
RAW	0.900*	0.821	0.700	1.000

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

HAC: Hearing about composting

KOC: Knowledge on composting

NPC: Number of people composting

RAW: Reducing amount of waste

This results show a significant positive correlation ($r_s = 0.975$, at $p = 0.01$) between knowledge on composting and number of people involved in composting municipal solid waste (Table 1). The strong relationship suggests that if the communities are knowledgeable about composting, it will enhance increased participation and hence the amount of waste composted. Thus the success of composting in recipient communities could be achieved by intensifying awareness through education, sensitisation and technology demonstration. These findings are in line with those of Grodzińska-Jurczak *et al*, (2006) who found that in Jasło City (Poland), the educational programme using home advisors conducted continuously for 24 months resulted in a significant increase of recycled wastes and the number of inhabitants joining the action.

Table 1 also shows that the amount of waste reduced is significantly correlated with hearing about composting ($r_s = 0.900$, at $p = 0.05$). This implies that as people are sensitised about composting, they get to appreciate its benefits as reducing the amount of waste dumped in the environment. Thus the more people appreciate benefits of composting municipal solid waste, the more they compost hence reducing the amount of waste dumped in the environment. These results are in agreement with those of Thomas (2001), who observed that a recycling

scheme might be made more effective by improving participants understanding of the schemes requirements by publicity and education.

4.3 Recipient community willingness to compost municipal solid waste (objective two)

Willingness to compost municipal solid waste was assessed through setting aside of materials for composting, collection of organic matter from municipal solid waste dumping site, acceptance to compost based on environmental and economic benefits and adoption of municipal solid waste composting technology.



Fig. 4: Compost mining by recipient communities of Ewuata.

Compost mining spots

Incentives by a few members of the recipient communities to mine compost for use in crop production as in Fig. 4 above is a good indication of willingness to compost municipal solid waste.

Findings for willingness to compost show that most people usually set aside materials for composting (70%) while few (30%) do not. Much as a good number of respondents set aside materials for composting, only 13% collect it from municipal solid waste dumping site. This could be because of some of the factors which the people consider as hindrance to composting municipal solid waste in this community. Among these factors considered most likely to hinder composting to greater extent are health risk, quality of garbage, foul odour and financial constraints because they were mostly rated as high to very high hindrance factors (Fig. 5).

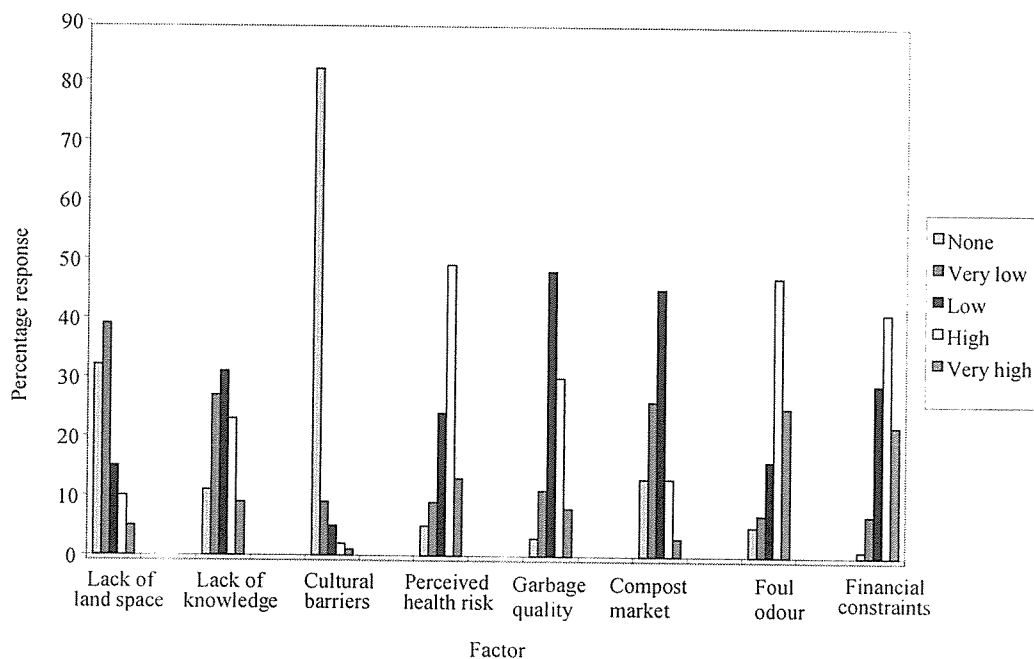


Fig. 5: Factors hindering composting in recipient communities

Table 2: Spearman's Correlation coefficient (r_s) of variables on factors that affect willingness to compost municipal solid waste.

	LS	LK	CB	HR	QG	LM	FO	FC
LS	1.000							
LK	0.500	1.000						
CB	0.900*	0.300	1.000					
HR	-0.600	0.300	0.700	1.000				
QG	-0.100	0.800	0.300	0.800	1.000			
LM	0.700	0.900*	0.600	-0.100	0.500	1.000		
FO	-0.800	-0.100	0.900*	0.900*	0.500	-0.500	1.000	
FC	-0.600	0.300	0.700	1.000**	0.800	-0.100	0.900*	1.000

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

LS: Land space CB: Cultural barriers QG: Quality of garbage FO: Foul odour
 LK: Lack of knowledge HR: Health risk LM: Lack of market FC: Financial risks

Cultural barrier is positively correlated to land ($r_s = 0.900$, at $p = 0.05$) suggesting that land use in this community as in many other rural/peri-urban communities is determined by elders who are culturally respected in the society. Similarly land acquisition in this community is through inheritance from ones' ancestors which is rooted to culture. The importance of culture in issues relating to land has also been shown by Green (2005) that in Niger, land is traditionally seen among the Songhai as part of common inheritance which could not be bought or sold without severing the relationship between the present cultivators and their ancestors and that understanding ethnic attachment to land is necessary in understanding current attempts at land tenure reform. Thus land utilization for municipal solid waste composting in recipient communities needs to take into consideration the culture of the community for its success. For people to be willing to compost municipal solid waste, the availability of land as well as the culture of the people are important determinants of the success of such a scheme.

Municipal solid waste compost marketing is significantly correlated with knowledge on composting ($r_s = 0.900$, at $p = 0.05$) implying that only people with knowledge on composting of municipal solid waste are the ones who can compost municipal solid waste and know compost markets. Thus imparting composting knowledge to recipient communities will help in discovering more markets for compost produced. With increased markets, more people will be willing to compost municipal solid waste in recipient communities. The results are in agreement with those of Asnani, (2006) that marketing of compost is a major concern for private operators and that lack of awareness among the farmers regarding the benefits of using compost is an impediment to its sale. The importance of knowledge of municipal solid waste composting in relation to compost marketing has also been recognised by Hoornweg (1999) who stated that, the first step in developing a marketing strategy is to assess all existing and potential markets and that this requires knowledge of the product, potential uses, limitations on use, and estimating the value of the product to the user. This is also in agreement with Kaosol (2009) who observed that composting is not well practiced in Thailand due to the lack of knowledge and high costs in maintenance.

The results (Table 2) also show that most people associate foul odour of municipal solid waste with health risks ($r_s = 0.900$, at $p = 0.05$). Associating foul odour of municipal solid waste with health risk seems to affect people's willingness to compost municipal solid waste for fear of contracting diseases in the process. These results are in agreement with those of Zurbrug *et al*, (2002) who indicated that odour complaints of residents living near to the composting site, and the lack of municipal support and formal acknowledgement are the main challenges composting schemes face. These observations are also in line with Kurian, (2007) who stated that the amenity impacts of open window composting are considerable, with such facilities generating many complaints regarding odour and dust emissions and that control of local odour dispersion has remained a key factor in siting of such facilities. These findings further supports the arguments of Domingo and Nadal, (2009) that although odour perception and its grading are

influenced by experience, attitude and adaptation, these emissions have created a lack of acceptance for residents in the vicinity of composting facilities.

Financial constraints is significantly associated with health risk ($r_s = 1.00$, at $p = 0.01$) justifying the need for financial resources in prevention and treatment of diseases and health risks associated with composting of municipal solid waste. The costs could be inform of buying protective gears such as gumboots, overall, masks etc for prevention purposes and medical expenses incurred in actual treatment of diseases. Financial constraints is also significantly related to foul odour ($r_s = 0.900$, at $p = 0.05$) probably justifying the need for finances required to prevent foul odour or health risks that municipal solid waste composting may present. Financial constraints are likely to have greater influence on willingness to compost municipal solid waste. Ambat and Saharsh, (2003) found out that low willingness of households to participate in collection and recycling depend on the perceived benefits and costs of the system. This also supports the findings of Chakrabarti *et al*, (2009) that the system of payment of money/incentives for providing services should be implemented as this arrangement is more cost effective than total management by public authority. This is also consistent with Tam and Tam, (2008) who showed that reward schemes and incentive systems contribute to awareness and motivation regarding waste reduction. Thus policies should be formulated to focus on raising awareness, promoting knowledge and motivating recipient communities with regard to composting and waste management practices.

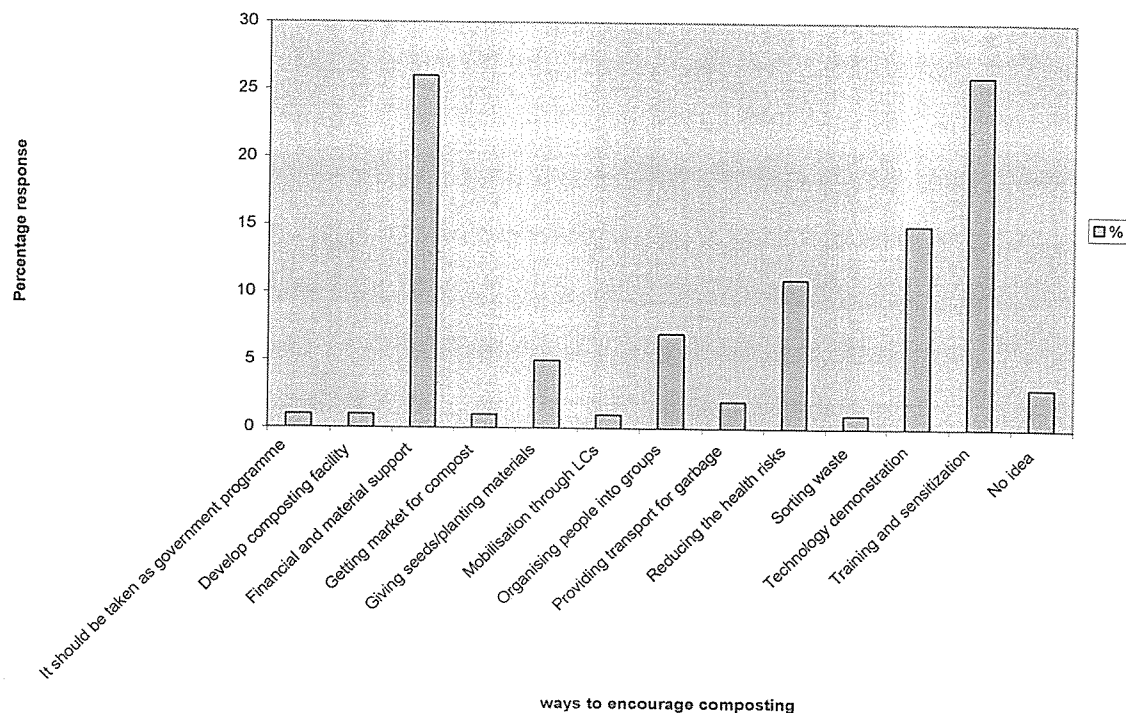


Fig.6: The best ways to encourage composting municipal solid waste

To best encourage composting, several ways were suggested by the respondents and these are shown in Fig. 6. The most frequent ways mentioned were training and sensitization (26%), financial and material support (26%), technology demonstration (15%) and reducing health risks (11%). Also of importance were organising people into groups (7%) and free distribution of seeds and other planting materials (5%). The general perception is that people are willing to compost if there are some prior benefits or incentives given to them. This is in agreement with the findings of Bolaane, (2006) that the general attitude of households would be more inclined to practise recycling if they could benefit financially from separating and returning the materials and that their interest to separate materials that attract a monetary value could limit source separation of the materials that do not produce financial rewards. Similarly, Singh *et al*, (2007) also advocates for community motivation to solve their common problems so that they become agents of their own development instead of positive beneficiaries of development aid.

4.4 Feasibility of municipal solid waste composting in recipient communities (objective three)

Feasibility in this study is used to mean whether municipal solid waste composting is achievable, attainable or practicable in recipient communities. This was determined by assessing support for separation of organic portions of municipal solid waste, fear for health risks, weighing the benefits against perceived health risks associated with composting, agreement with encouraging composting and rating responsibility of some stakeholders in initiating and promoting composting.

Table 3: Feasibility of municipal solid waste composting in recipient communities (n=150)

	Count	%	Count	%	Count	%	Count	%	Count	%					
Separations of organic portions from MSW	Strongly disagree	0	0	Disagree	3	2	Unsure	3	2	Agree	57	38	Strongly agree	87	58
Health risk associated with composting	No risk	6	4	Unsure	4	3	Low risk	15	10	Moderate risk	63	42	High risk	62	41
Benefits outweigh risks	No	13	9	Unsure	23	15	Slightly	53	35	Much	48	32	Very much	13	19
Encouraging more people to compost	Strongly disagree	0	0	Disagree	4	3	Unsure	3	2	Agree	76	51	Strongly agree	67	45

As shown in Table 3, most respondents support separation of organic portions of municipal solid waste before dumping since they either agree (38%) or strongly agree (58%) with the idea. This support if encouraged could make municipal solid waste composting feasible in this community. This finding is in agreement with Zurbrug *et al*, (2002) who stated that composting necessitates a higher level of participation by the residents as all schemes rely on waste where the "wet" biodegradable fraction has been kept separate from other wastes.

As far as health risks associated with composting are concerned, majority of the respondents rate it as moderate (42%) and high risk (41%). However, they acknowledge that the benefits of composting much (35%) and very much (32%)

outweigh the perceived health risks. Majority of the respondents generally agree (51%) and strongly agree (45%) to encouraging composting municipal solid waste for use in crop production.

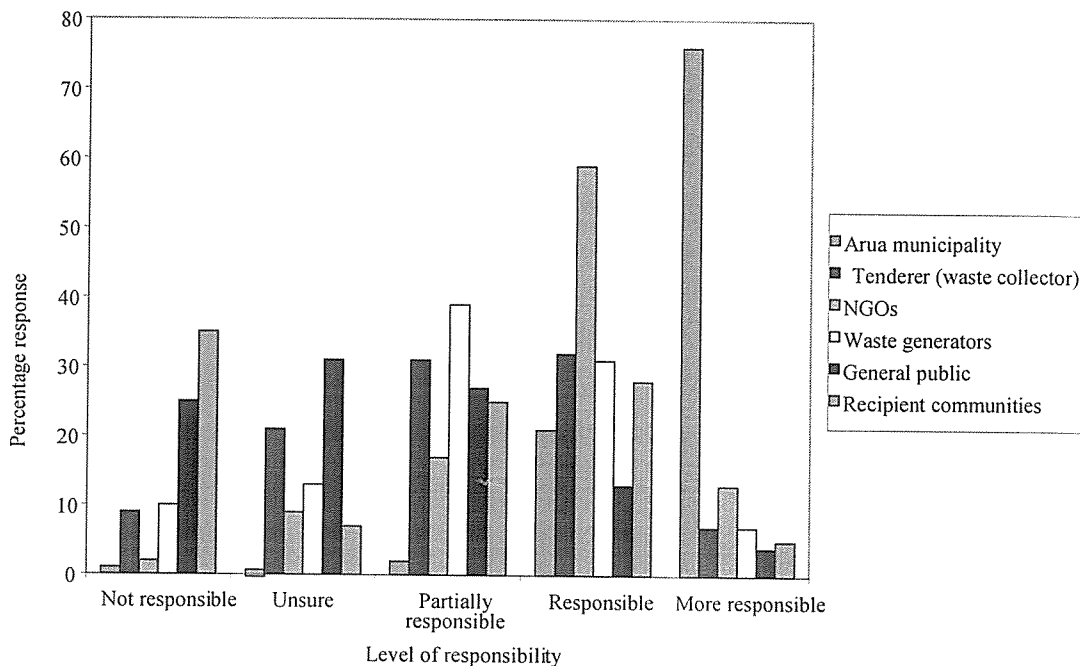


Fig. 7: Level of responsibility of some stakeholders.

They placed much of the responsibility for initiating and promoting composting on Arua municipality and NGOs (Fig. 7). This is probably because NGOs play a crucial role in reaching communities helping to create awareness about the environmental impacts associated with poor waste management. This is consistent with the findings of Bolaane, (2006) that municipal authorities are a key stakeholder in formal recycling, with the expectation that they will initiate and implement recycling schemes and that, municipalities and NGOs in developing countries are embracing source separation as a viable strategy for sustainable waste management. This implies that success of composting municipal solid waste in recipient communities could be realised if it is initiated and promoted by the municipality or NGOs. These findings show that municipal solid waste composting is feasible in recipient communities of Ewuata since most members agree with separation of the organic portions for composting and at same time acknowledge that municipal solid waste composting benefits outweigh the perceived health

risks. Participation and coordination by different stakeholders is thus necessary for success of municipal solid waste composting in recipient communities.

Table 4: Spearman's Correlation coefficient (r_s) of responsibility of some stakeholders of municipal solid waste composting (n=150).

	AM	WC	NG	WG	GP	RC
AM	1.000					
WC	0.205	1.000				
NG	0.359	0.700	1.000			
WG	0.462	0.900*	0.600	1.000		
GP	0.667	0.300	0.300	0.500	1.000	
RC	0.616	0.400	0.100	0.300	0.100	1.000

* Correlation is significant at the 0 .05 level (2-tailed).

AM: Arua municipality WC: Waste collector RC: Recipient community
 NG: Nongovernmental organisation WG: waste generator GP: General public

Analysis of the roles different stakeholders are expected to play as in Table 4 indicate that there is a significant correlation between waste generators and waste collectors ($r_s = 0.900$, at $p = 0.05$). The results seem to show the cooperation expected from the two parties during municipal solid waste management. This cooperation could be in terms of frequency of waste collection after generation and temporary storage arrangements at generation points or in terms of source separation. These findings are in line with those of Hoornweg (1999) that participation and cooperation from many stakeholders is required, including national governments, municipalities, local communities, waste generators, and the private sector to enhance municipal solid waste composting efforts. The importance of stakeholder participation has also been acknowledged by Zotos (2009) who stated that initiatives to improve waste management services and the overall sustainability of environmental policy chosen by local authorities require participation of all involved parties in order to be successful. Participation by all stakeholders is thus essential in municipal solid waste management in general but composting in particular with respect to source segregation, recovery of reusable materials and recyclables and storage of the garbage prior to collection.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Recipient communities of Ewuata are generally aware of composting and compost use but the awareness does not necessarily translate into practicing composting. The communities are however willing to compost municipal solid waste but they lack knowledge of composting, compost application and compost marketing. Foul odour of the decomposing garbage from the dumping site, perceived health risks and lack of finances discourages the communities from composting the municipal solid waste. This is mainly because of fear to contract diseases which has financial implications in terms of costs involved in treatment.

Recipient communities are central to the success of municipal solid waste composting. It is important that in order to appreciate possible constraints in municipal solid waste composting, we understand the perceptions of recipient communities towards it. The emerging trend is that municipal authorities and NGOs are key stakeholders in formal composting, with the expectation that they will initiate and implement composting schemes. This implies that success of composting municipal solid waste in recipient communities could be realised by municipal/NGO involvement of the recipient communities in such initiatives.

From the results, it can be concluded that much as recipient communities are aware of composting and are willing to compost municipal solid waste they cannot practice composting without some incentives given to them. Such incentives from the government or NGOs will help to motivate the people and mitigate some of the hindrances/constraints to composting. This suggests that, in Arua district, composting initiatives undertaken in recipient communities of municipal solid waste should have financial incentives. To this end, a combination of material support (like hand tools, protective gears etc), technology demonstration, free distribution of planting materials, training and sensitization workshops will be the most appealing methods.

5.2 Recommendations

- In order to stimulate practical composting, Public awareness programmes intended to promote organised composting of municipal solid waste in recipient communities should be carried out. This should be done with full involvement of the different stakeholders.
- Imparting knowledge for example through publicity, constant education, sensitisation and technology demonstration in recipient communities of municipal solid waste should be carried out by the waste management authority i.e. Arua municipality or NGOs to enhance increased participation in municipal solid waste composting and amount of waste composted.
- A combination of financial and material support and other benefits should be provided to the recipient communities as a way of motivation to improve willingness to compost municipal solid waste.
- This study further recommends robust actions by Arua municipality as waste management authority to integrate the private sector with communities for improving the quality of compost and to provide marketing at the regional level.
- Any steps planned to achieve the common goal of sustainable waste management and composting in particular should be open for re-evaluation to accommodate the dynamics of the society.

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APPENDICES

APPENDIX A: QUESTIONNAIRE

Dear respondent I'm Amandua Ecebo Joseph a student of school of engineering and applied sciences, Kampala International University pursuing Master of Science in Environmental Management. I'm carrying out research on recipient community perception towards composting of municipal solid waste in Arua district. I kindly request you to respond honestly to each statement by ticking in the tables/boxes or writing in the spaces provided where appropriate. Your responses will be completely confidential and used for purpose of this research only.

SECTION A: BIO-DATA.

1. Sex: Male..... Female.....
2. Age: 15-19.... 20-24.... 25-29.... 30-34.... 35-39.... 40-44.... 45-49.... 50-54....
55-59.... 60+....

SECTION B: Composting awareness and compost use.

A1. Do you ever hear about composting and compost use?

1. Never	2. Almost never	3. Sometimes	4. Frequently	5. Very frequently

A2. If you heard about composting and compost use, where did you get the information from?

1. Friends	2. Government officials	3. Medias such as newspaper, radio, etc	4. Community meetings	5. Social gathering e.g church, markets, funerals, etc

A3. Have you ever seen people using compost in gardens any where?

1. No ☐

2. Yes ☐

A4. If *yes* how many have you seen in this community?

1. None	2. Very few	3. Few	4. Many	5. Very many

A5. Do you have any knowledge on composting?

1. None	2. Very little	3. Little	4. Much	5. Very much

A6. To what extent do you think composting can reduce the amount of waste dumped in the environment?

1. None	2. Very little	3. Little	4. Much	5. Very much

A7. Which of the following benefits of composting is more important to you?

1.Improved environmental quality	2. Improved soil fertility and crop yield	3. Reduced foul odour	4. Reduced likelihood of disease infection	5. None

SECTION C: Willingness to compost municipal solid waste

W1. Do you usually set aside materials from your waste for composting?

1. No ☐

2. Yes ☐

W2. Have you ever collected organic matter from the municipal solid waste dumpsite for use?

1. No ☐

2. Yes ☐

W3. Given the environmental and economic benefits of composting, would you accept to compost for these benefits?

1. Not accept	2. Not sure	3. Accept	4. Much accept	5. Very much accept

W4. What are you going to do if the government or any organization proposes an innovative technology for composting municipal solid waste in your community?

1. Ignore the technology	2. Unsure	3. Just wait and see	4. Adopt the technology	5. Adopt the technology instantly

W5. To what extent do you think the following factors are likely to hinder composting in your community?

	1. None	2. Very low	3. Low	4. High	5. Very high
Lack of land space					
Lack of knowledge					
Cultural barriers					
Perceived health risks					
Poor quality of garbage					
Lack of market for compost					
Foul odour					
Financial constraints					

W6. How best do you think composting can be encouraged in this community?

SECTION D: Feasibility of municipal solid waste composting.

F1. Potentially valuable materials (organic portions) should be separated for composting from MSW before dumping.

1. Strongly Disagree	2. Disagree	3. Unsure	4. Agree	5. Strongly Agree

F2. Do you think there is any health or environmental risks associated with composting municipal solid waste?

1. No Risk	2. Unsure	3. Yes- Low Risk	4. Yes- Moderate Risk	5. Yes – High Risk

F3. Do you think the benefits of composting municipal solid waste outweigh any perceived health or environmental risks associated with it?

1. No	2. Unsure	3. Yes – slightly	4. Yes- much	5. Yes – very much

F4. People should be encouraged to compost more municipal solid waste for use in crop production.

1. Strongly Disagree	2. Disagree	3. Unsure	4. Agree	5. Strongly Agree

F5. How responsible do you think the following people should be for initiating and promoting composting?

	1. Not Responsible	2. Unsure	3. Partially Responsible	4. Responsible	5. More Responsible
Arua municipality					
Tenderer (waste collector)					
NGOs					
Waste generators					
General public					
Recipient communities					

Thank you for your time.

APPENDIX B: RAW DATA

Awareness on composting and compost use (n=150)

	Count	%	Count	%	Count	%	Count	%	Count	%
Hearing about composting	Never 1	1	Almost never 11	7	Sometimes 90	60	Frequently 44	29	Very frequently 4	3
Source of information	Friends 43	29	Government 48	32	Media 41	27	Community meeting 16	11	Social gathering 2	1
Sight of people using compost	No 8	5	Yes 142	95						
Number of people using compost	None 12	8	Very few 39	26	Few 82	55	Many 12	8	Very many 5	3
Knowledge on composting	None 35	23	Very little 44	29	Little 45	30	Much 22	15	Very much 4	3
Extent of reducing amount of waste	None 5	3	Very little 38	25	Little 57	38	Much 36	24	Very much 14	9
More important composting benefit	Environmental qlty 8	5	Soil fertility 106	71	Reduced odour 19	13	Reduced diseases 14	9	None 3	2

Recipient community willingness to compost (WTC) municipal solid waste (n=150)

	Count	%	Count	%	Count	%	Count	%	Count	%
Set aside materials for composting	No		Yes							
	45	30	105	70						
Collecting organic matter from MSW site	No		Yes							
	131	87	19	13						
Acceptance to compost MSW	Not accept		Not sure		Accept		Much accept		Very much accept	
	11	7	8	5	56	37	39	26	35	24
Adoption of MSW composting technology	Ignore technology		Unsure		Just wait to see		Adopt		Adopt instantly	
	1	1	3	2	17	11	80	53	49	33

Factors hindering composting in recipient communities (n=150)

	<u>None</u>		<u>Very low</u>		<u>Low</u>		<u>High</u>		<u>Very high</u>	
	count	%	count	%	count	%	count	%	count	%
Lack of land space	48	32	58	39	22	15	15	10	7	5
Lack of knowledge	16	11	40	27	46	31	34	23	14	9
Cultural barriers	123	82	14	9	8	5	3	2	2	1
Perceived health risk	8	5	13	9	36	24	73	49	20	13
Poor quality of garbage	5	3	16	11	72	48	45	30	12	8
Lack of compost market	20	13	39	26	68	45	19	13	4	3
Foul odour	7	5	11	7	24	16	70	47	38	25
Financial constraints	2	1	11	7	43	29	61	41	33	22

How composting can best be encouraged in recipient communities (n = 150)

Best way to encourage composting	Count	%
It should be taken as government programme	1	1
Develop composting facility	1	1
Financial and material support	39	26
Getting market for compost	1	1
Giving seeds/planting materials	8	5
Mobilisation through LCs	2	1
Organising people into groups	10	7
Providing transport for garbage	3	2
Reducing the health risks	17	11
Sorting waste	2	1
Technology demonstration	23	15
Training and sensitization	39	26
No idea	4	3

Level of responsibility of some stakeholders (n=150)

	<u>Not</u>		<u>Unsure</u>		<u>Partially responsible</u>		<u>Responsible</u>		<u>More</u>	
	<u>responsible</u>								<u>responsible</u>	
	Count	%	Count	%	Count	%	Count	%	Count	%
Arua municipality	1	1	2	1	1	2	31	21	114	76
Tenderer (waste collector)	13	9	32	21	47	31	48	32	10	7
NGOs	3	2	13	9	26	17	88	59	20	13
Waste generators	15	10	19	13	59	39	47	31	10	7
General public	32	25	47	31	40	27	20	13	6	4
Recipient communities	52	35	11	7	38	25	42	28	7	5



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