PERCEPTUAL ASSESSMENT OF EFFECTIVENESS OF THE BAUCHI STATE ENVIRONMENTAL PROTECTION AGENCY IN MUNICIPAL SOLID WASTE MANAGEMENT IN BAUCHI METROPOLIS, NIGERIA

BY

Bilkisu A. BAPPAH, BTECH (ATBU) 2010

MSC/SCIE/38562/2012 - 2013

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER DEGREE IN ENVIRONMENTAL MANAGEMENT

DEPARTMENT OF GEOGRAPHY,

FACULTY OF SCIENCE,

AHMADU BELLO UNIVERSITY

ZARIA, NIGERIA

FEBRUARY, 2017

DECLARATION

I hereby declare that the work in this thesis titled “Assessment of the effectiveness of the Bauchi state environmental protection agency in municipal solid waste management in Bauchi metropolis, Bauchi state, Nigeria” was carried out by me in the Department of Geography, Ahmadu Bello University, Zaria. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this work has been previously presented for another degree or diploma at this or any other institution.

_____	_____	_____
Name of Student	Signature	Date

CERTIFICATION

This thesis titled,ASSESSMENT OF THE EFFECTIVENESS OF THE BAUCHI STATE ENVIRONMENTAL PROTECTION AGENCY IN MUNICIPAL SOLID WASTE MANAGEMENT IN BAUCHI METROPOLIS, BAUCHI STATE, NIGERIA by BILKISU A. BAPPAH meets the regulations governing the award of the degree of M.SC Environmental Management of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Prof. A. B. Nabegu	_____	_____
Chairman, Supervisory Team	Signature	Date
Dr. B. Akpu	_____	_____
Member, Supervisory Team	Signature	Date
Dr. A. K. Usman	_____	_____
Head of Department	Signature	Date
Prof. K. Bala	_____	_____
Dean, Post Graduate Studies	Signature	Date

DEDICATION

To Mama (Hajiya Safiya Matanliman) and Baba (Dr. Ahmadu Bappah) for everything.

ACKNOWLEDGEMENTS

All praises are due to the creator Allah (SWT) the most merciful, beneficent and master of everything.I would like to sincerely thank my supervisors, Prof. A.B. Nabegu and Dr. B. Akpu for their scrutiny and constructive criticisms. Their valuable insights played a critical role in ensuring the emergence and success of this work.

My beloved parents, Dr. Ahmadu Bappah and Hajiya Safiya Matanliman deserve endless appreciationandgratitude for theirpatience, understanding and support. They mean the world to me.My profound appreciation goes to Aunty Awaja, Goggo Amina, Ya Ai and Zem for being there for me when I needed them most. Their contributions toward the success of this study are greatly appreciated

My sincere appreciation goes to my siblings Ya Patu, Ya Umaru, Amina and Yaya for being there for me always. I must thank Uncle Nasir Usman Liman for his encouragement and support. My gratitude also goes to Dr Ahmad Abubakar of the Pharmacy Department, ABU, Zaria.

Aunty Ladi and her family deserve a special mention for the hospitality, prayers and support they accorded me throughout my period of stay in Zaria. I am indebted to my dear cousin Dr. Umaru Hassan (Baaba) for always helping me out in my times of need. Thanks also to Umaru's friends, my cousin Bauchi Bello, Mariya Mukaddas and Adamu Tukur for helping me out with the questionnaire distribution.

A study like this depends greatly on the collective help and support of people and I am particularly grateful to Abdulwahab Kolo, Bappah Muusa, Bappah Ibrahim, Kubra Almustapha for all that they rendered.

I wonder what life in ABU would have been like without the friendship and support of most especially Fati Ali Maidugu, Aisha Atiku, and Ummi Shehu. These people made my post graduate studies worthwhile and I can't thank them enough.

I would like to thank the staff and management of the Bauchi State Environmental Protection Agency for providing me with most of the information used for this study. My special appreciation goes to the Director General Alhaji Waziri Yahaya Jalam, Director of Planning Alhaji Mohammed Kabir and the directors of Waste management and Urban and Regional planning Departments.

I would also like to thank Zainab Ismai'l, Rabi'u Bala, Sikirat Kehinde Aina, Maryam, Maskurah Ahmad, Ruqayya Gebi, Al'amin Dabo,Yusuf Dabo and Doyin Sanni and Abdul Wakawa for their help and support.Finally, to those who have helped me in one way or other in my life, not mentioned here because of space constraint, I thank them and pray that they all be rewarded abundantly.

ABSTRACT

The Bauchi State Environmental Protection Agency (BASEPA) is the government institution responsible for municipal solid waste management in Bauchi metropolis; it was established by edict No. 3 of 1997 and came into existence on 10th June, 1997. This study assesses the effectiveness of Bauchi State Environmental and Protection Agency (BASEPA) in Municipal Solid Waste Management in Bauchi metropolis. A stratified random sampling technique was used to select respondents for theadministration of 396 copies of questionnaire to households in twelve major wards of the metropolis. Data were analysed using descriptive statistics and Kruskal Wallis test. The result of the The Kruskal-Wallis (H) test revealed that there is a statistically significant difference in perception amongst the public with respect to the role of BASEPA in Municipal Solid Waste Management in Bauchi metropolis.BASEPA's administration and organisation of Municipal solid waste activities was rated lowest by respondents, getting a mean score of 606.80; BASEPA is the only Government institution responsible for municipal Solid waste Management in Bauchi metropolis and its activities are regulated by edict No. 3 of 1997. Also, more than half of the respondents (57.9%) are not satisfied with BASEPA's solid waste management services and most of the respondents also blame it for the poor solid waste management in the study area. Most of the respondents (81.3%) are willing to pay for solid waste evacuation; and most (30.5%) will like recycling to be introduced as an alternative method of managing solid waste.The study established that the major constraintof the BASEPA is inadequate funding, other constraints include the multiplicity of divergent functions. Based on the findings, the study recommends an edict review, re-strategizing BASEPA's administrative and organisational arrangements, construction of modern landfills and introduction of other solid waste management techniques such as sorting and recycling.

TABLE OF CONTENTS

Title Page……..i

Declaration……..……ii

Certification……..…....iii

Dedication……..…….iv

Acknowledgements……..……....v

Abstract……..……...….vii

Table of Contents……..……viii

List of Tables.....……..xi

List of Figures……...……..…xii

List of Plates……...……..….xiii

List of Appendices……..……...xiv

CHAPTER ONE: INTRODUCTION.....1

1.1 Background to the study……..…….1

1.2 Statement of the research problem……..……...5

1.3 Aim and objectives of the study……...…….9

1.4 Scope of the study……...…10

1.5 Justification of the study……...……..……10

CHAPTER TWO: CONCEPTUAL FRAMEWORK AND LITERATURE REVIE.12

2.1 Introduction……...12

2.2 Conceptual Issues……..12
2.2.1 Waste……..……...12
2.2.2 Municipal Solid Waste……..…13
2.2.3 Municipal Solid Waste Management……..…...14
2.2.4 Bauchi State Environmental Protection Agency (BASEPA)……..…...33

2.3 Literature Review……..….44
2.3.1 Laws and Institutions guiding Municipal Solid Waste Management ……...44
2.3.2 Municipal Solid Waste Management Practices, Perceptions and Attitudes……..48
2.3.3 Problems of Municipal Solid Waste Management……..……...52

CHAPTER THREE: STUDY AREA AND METHODOLOGY……..……56

3.1 Study Area……..…….56
3.1.1 Location……..……...56
3.1.2 Climate……..…….56
3.1.3 Relief and Drainage……..….58
3.1.4 Soils……..…….60
3.1.5 Vegetation……..…61
3.1.6 Population and Economic activity……..…62

3.2 Research Methodology……..…….63
3.2.1 Reconnaissance Survey……..…63

3.2.2 Types of Data……..……...63
3.2.3 Sources of Data……..…64
3.2.4 Sample size and sampling technique……..……65
3.2.5 Data analysis……..……67

CHAPTER FOUR: RESULTS AND DISCUSSION……...….70

4.1 Introduction……..…..70
4.2 Demographic and Socio-economic characteristics of respondents……..70
4.2.1 Sex of Respondents……70
4.2.2 Age, Education level and Occupation of Respondents……...…72
4.2.3 Marital status, Household size and Monthly Earnings of Respondents……74

4.3 The extent to which BASEPA has achieved its mandate on MSWM in Bauchi Metropolis……..…..…75

4.3.1 Name of Institution responsible for MSWM in Bauchi metropolis……..…..76
4.3.2 Methods of solid waste disposal in Bauchi metropolis……..…….77
4.3.3 Distribution of solid waste dumps, location and effects……..……...78
4.3.4 Responsibility for solid waste evacuation and payment in Bauchi metropolis……...82
4.3.5 Responses on sorting/separation/Segregation of solid waste before disposal……....83

4.3.6 Responses on role of sanitary inspectors in SWM in Bauchi metropolis……..84
4.3.7 Responses on ancillary services provided by BASEPA…….....87
4.3.8 Residents opinion on MSWM services by BASEPA…..……..……..89

4.4 Perception of the public with respect to the role of BASEPA in MSWM in Bauchi Metropolis……..……...92

4.4.1 Kruskal-Wallis test for Perception of the public with respect to the role of BASEPA in MSWM in Bauchi Metropolis……..……...92

4.5 Identify Public Domain Ways of Increasing the Effectiveness of the Bauchi state Environmental protection agency……..…93

4.5.1 Residents attitude towards poor solid waste management in Bauchi metropolis...….93

4.5.2 Community initiatives on solid waste management and participation……..……..95

4.5.3 Willingness to pay in order to improve on solid waste evacuation/collection service.96

4.5.4 Separation of waste and participation in other waste management programmes such As recycling, composting, etc……..……...97

4.5.5 Waste management techniques besidesevacuation that respondents will like to see Put to use in their environment……..……..99

4.6 Constraints to effective MSWM in Bauchi Metropolis……......100

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS..106

5.1 Summary……..…….106

5.2 Conclusion……..……...107

5.3 Recommendations…….108

References……..…….110

Appendices……..……117

LIST OF TABLES

Table 2.1 Machinery and plant use in MSWM by BASEPA…….44

Table 3.1 Household population and sample size……..67

Table 4.1 Age, Educational level and Occupation of respondents…….72

Table 4.2: Marital status, Household number and Monthly earnings of respondents……74

Table 4.3: Distribution of solid waste dumps, location and effects……...79

Table 4.4: Distribution of responses on responsibility for solid waste evacuation and payment in Bauchi metropolis……..……82

Table 4.5: Distribution of responses on the role of sanitary inspectors in solid waste management in Bauchi metropolis……..….86

Table 4.6: Distribution of responses on ancillary services provided by BASEPA…….88

Table 4.7: Distribution of resident's opinion on MSWM by BASEPA……...90

Table 4.8 Summary of the Kruskal-Wallis Test for the Perception of the Public with respect to the role of BASEPA in Municipal Solid Waste Management……...93

Table 4.9 Residents attitude towards solid waste mismanagement in Bauchi metropolis.94

Table 4.10: Distribution of responses on community initiatives on solid waste management and participation……..……..96

Table 4.11 Constraints to effective MSWM in Bauchi metropolis……101

LIST OF FIGURES

Figure 2.1: Organisational Structure of BASEPA……...41

Figure 3.1: Bauchi Metropolis Showing the Wards…….....57

Figure 4.1: Sex Distribution of respondents……...….71

Figure 4.2: Name of Institution responsible for MSWM in Bauchi metropolis…….76

Figure 4.3 Methods of solid waste disposal in Bauchi Metropolis……..…77

Figure 4.4: Distribution of responses on sorting/separation of solid waste before disposal.84

Figure 4.5: Responses on willingness to pay for solid waste evacuation services…..……97

Figure 4.6: Responses on willingness to separate waste and participate in other solid waste management programmes……..……..98

Figure 4.7 Waste management techniques besides evacuation that respondents will like to see put to use in their Environment……...……....99

LIST OF PLATES

Plate I:Cosmopolitan workers evacuating solid waste on the streets in Bauchi Metropolis.36

Plate II: Illegal Waste Dump by the Road side along Titin Nasarawa, Bauchi……..…..80

Plate III: An overflowed dump in Sabon Gari area……..…80

Plate IV: A Dumpsite close to Residential buildings in Bakin Kura Area……...81

LIST OF APPENDICES

Appendix I Questionnaire……..…….117

Appendix II Interview Guide……..…..124

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The issue of Solid Waste Management has been top on the agenda in many gatherings. For instance, in 1992, the United Nations Earth Summit of Rio de Janeiro highlighted and channelled efforts in understanding and acting on solid waste problems, making it a key issue to be tackled in trade and commerce, economic and social development and in science and technology. Thus, the Rio conference endorsed the Agenda 21 Declaration where it called for promotion of sufficient financial and technological capacities at the regional, national and local levels as appropriate to implement waste management policies and actions (United Nations Conference on Environment, 1992).

The term waste(also known as rubbish, trash, refuse, garbage, junk, and litter) has been defined by The European Environmental Agency [EEA] (2009), under the Waste Framework Directive 75/442/EEC as an object the holder discards, intends to discard or is required to discard. Items considered as waste according to the same document include household rubbish, wastes from manufacturing activities, packaging items, discarded cars, old televisions, garden waste, and old paint containers. Thus all our daily activities can give rise to a variety of wastes arising from different sources (EEA, 2009).

Wastes are typically classified as solid, liquid and gaseous which could be bio-degradable, semi-biodegradable and non-biodegradable. Solid waste is any non-liquid and non-gaseous product of human activities, regarded as being useless. It could take the form of refuse, garbage and sludge (Leton and Omotosho, 2004). Municipal solid waste (MSW) is thus defined to include refuse from households, non-hazardous solid waste from industrial,

commercial and institutional establishments (including hospitals), market waste, yard waste, and street sweepings (Ogwueleka, 2009).

Globally, waste generation rate is on the increase and constitutes risks to both human health and environment. According to the Organisation for Economic Co-operation and Development [OECD] (2002) report on municipal waste generation rate for member countries, the rate is expected to rise from 100 million tonnes annually in 1980s to approximately 168 million tonnes by 2015 and above 250 million tonnes by 2030.

In Nigeria, a major feature of the urban environment, particularly from the beginning of the oil boom in the 1970's was the rapid takeover of cities by all kinds of solid waste as a result of increase in solid waste generation. For example, according to the Federal Environmental Protection Agency [FEPA] (1991) about 20kg of domestic waste was generated per capita per year before the 1990s in Nigeria but by 2003, it was documented that waste generation has increased to about 212kg per capita per year (Sridhar and Adeoye, 2003). The growth of industries and subsequent increase in the number of people living in towns and cities (i.e. urbanisation) brought about this major increase in waste generation. With the increase in quantity of waste generated, comes the problem of management (Babanyara, Saleh and Usman, 2010).

According to the European Environmental Agency (2009), waste management refers to the collection, transportation, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites. Thus, Municipal Solid Waste Management (MSWM) encompasses the functions of collection, transfer, resource recovery, recycling, and treatment of domestic waste. The primary target is essentially to protect the health of the population, promote environmental quality, and to enhance economic productivity.

Management of solid waste has become a major public health and environmental concern in urban areas of many developing countries despite the fact that they spend over 30% of their budgets on it (United Nations Development Programme (UNDP), 2002). The problem of managing solid waste is caused by poor waste collection, storage, disposal, inadequate facilities, poor funding/implementation and wrong life style, leading to subsequent pollution and environmental degradation (Adora, 1997; Ogunyenmi, 1997; Thomas, 1998; Ramachandra and Shruthi, 2007).

Solid waste generated in urban areas needs to be managed properly in such a way that it minimises risk to the environment and human health. In Nigeria, urban waste management is drawing increasing attention as citizens observe that too much garbage is lying uncollected on the streets, causing inconveniences and environmental pollution and being a risk to public health. Municipal solid waste management (MSWM) is a complex task which depends as much upon institutional arrangements, cooperation between households, communities, private enterprise as well as the selection and application of appropriate technical solution for waste collection and disposal (Nabegu, 2008).

The Federal Ministry of Environment administers and enforces environmental laws in Nigeria including municipal solid waste management through the National Environmental Standards Regulations and Enforcement Agency (NESREA). It took over this function in 1999 from the Federal Environmental Protection Agency (FEPA), which was created under the FEPA Act of 1988. Pursuant to the FEPA Act, each state and local government in the country sets up its own environmental protection body for the protection and improvement of the environment within its jurisdiction (Babanyara, Saleh and Usman, 2010).

Amongst other responsibilities, the State and Local Government environmental agencies are responsible for the handling, employing and disposing of solid waste generated. The state agencies are funded by the state governments and internally generate revenue through sanitary levy and stringent regulations with heavy penalties for offenders of illegal dumping and littering of refuse along streets (Ogwueleka, 2003).

The Bauchi State Environmental Protection Agency (BASEPA) is the government institution responsible for municipal solid waste management in Bauchi metropolis; it was established by edict No. 3 of 1997 and came into existence on 10th June, 1997. But with the increase in complexity and volume of waste generation and to improve the sanitation condition in the state, the Bauchi state government on 27th October, 2007 entered into public-private partnership initially with Cosmopolitan Cleaners. Later on, the National Union of Road Transport Workers (NURTW) Tipper branch, Community Based Organizations (CBOs) such as Bauchi Youth Forum, Women Initiative for Change and Gwallaga Youth Forum and other private waste companies such as Ken-Hedges and Talatu Ventures were included. Under this partnership, BASEPA and these organisations, cooperate in the collection and disposal of refuse, street sweeping, managing landfill/dump sites, establishment of performance standards and enforcing waste management regulations. Also, BASEPA monitors and regulates the activities of the private Companies and Community Based Organisations (CBOs) with regards to solid waste management (Usman and Mohammed, 2012).

Despite these arrangements and efforts put in place by BASEPA, effective Municipal solid waste management is yet to be achieved in Bauchi metropolis. Ogwuche (2013) documented that while 40% of the solid wastes generated are managed by the Agency, 30% are indiscriminately dumped in unauthorized spots all around the metropolis constituting risks to

both human health and the environment. Hence the need to assess the effectiveness of the Bauchi State Environmental Protection Agency in managing Municipal solid waste in Bauchi metropolis.

1.2 STATEMENT OF THE RESEARCH PROBLEM

The oil boom of the 1970s and the concomitant explosion of industrial, commercial and population growth in most of the cities have resulted in an alarming growth in waste generation that successive governments have failed to efficiently solve (Nabegu, 2008).

In Nigeria's urban centres, solid waste consisting of millions of tons of bottles, cans, food scrap, plastics, abandoned broken down vehicles, dead animals etc. are generated every year (Nabegu, 2008). When dumped into water drains they contribute to flooding. The annual flood on the banks of Jakara and Gogau stream in Kano city (old city) and Fagge areas have been associated with refuse dumped improperly along and in the river channels (UNDP,1998). When dumped in improper landfills, they can contaminate water, soil and air with disease spreading bacteria. A more serious risk is the release of toxic substances which arise from natural decomposition process and incomplete combustion of the incinerated waste (Callan and Thomas, 1996). Thus, the environmental damage associated with solid waste mismanagement cuts across all media - land, water, soil, and air, which makes it widespread, difficult to control and costly to the society. According to the World Health Organisation (WHO) (2003), more than two thirds of humanity has improper or no facilities for solid waste disposal, a situation which leads to a vicious cycle of disease and poverty that is detrimental to social welfare and economic development.

In Nigeria, it has been documented that between 25% - 40% of the solid waste generated in urban centres is often not evacuated but dumped in drainage channels, open land,

uncompleted buildings and even along urban streets (Nabegu, 2008). It is this deplorable condition that led Mabogunje (1980) to conclude that Nigerian cities are reputed to be some of the dirtiest, the most unsanitary, the least aesthetically pleasing, least safe and secure and the most poorly governed cities of the world.

Nabegu and Mustapha (2015) conducted a desk study of the legal and institutional arrangement of Solid Waste Management in Nigeria and of the Kano state agency responsible for Solid Waste Management i.e. the Refuse Management and Sanitation Board (REMASAB). Results from this study indicate that the current institutional arrangement is weak and leads to inefficiency in service delivery. Also, the legal provisions show a clear lacuna leading to lack of coordination and conflict between the federal, state and local governments. The authors argued that improvement of solid waste management in Kano metropolis requires promotion of an institutional and legal framework that has very well defined roles and responsibilities for those involved in the chain.

The issue of municipal solid waste management in Bauchi metropolis is not different from what is obtained in other towns/cities in Nigeria. The waste management strategies are inefficient to effectively solve the problem of waste. According to Babanyara and Bogoro (2011), large quantities of solid waste have persistently accumulated in Bauchi metropolis which the Agency responsible has failed to effectively evacuate.

It could easily be summarized that what is obtainable as solid waste management in Bauchi metropolis is the collection, transporting and subsequent disposal of unsorted municipal refuse from the sources of generation to final disposal at dump sites. The main dump site is located east of the town about 10km along Bauchi- Gombe road. Other dump sites also exist

along Jos road to the west and Kano road in the north. Management of dump site is usually done by BASEPA.

The dump site or landfill site is usually an open burrow pit, or open space along the major highways, exposed to vagaries of weather. And because the waste is not treated or processed before final disposal, the possibility of leachate percolating through the soil and contaminating the water table of the nearby villages is very high. Open air incineration with its attended pollution of the atmosphere to reduce the volume of the waste is usually carried out at the disposal dump sites.

Section 10 (11) of the edict No. 3 of 1997, grants BASEPA the power to stop any act or omission that is in violation of any principle of decent environment. This is one of the shortcomings of the edict i.e. it is vague and not specific. Violations of the principle of a decent environment can come in different forms e.g. dumping of waste in drainages, not evacuating waste as at when due, etc. all these constitute violations and a specific and clearly stated penalty will go a long way in checking these violations. As it is, because there are no specifically stated penalties for these violations, most defaulters get away with it hence the lack of effectiveness in MSWM in Bauchi metropolis.

The issue of municipal solid waste management in Bauchi metropolis has been researched upon by different authors. For example, Babanyara and Bogoro (2011) conducted a research on Evacuation of Solid Waste in residential areas of Bauchi Metropolis, Nigeria. The research was aimed at identifying factors responsible for continuous accumulation and emergence of new heaps of solid waste in Bauchi metropolis. Findings of this research revealed that the Bauchi State Environmental Protection Agency is the only organ that

evacuates solid waste generated in Bauchi metropolis and the collection centres are few which led to emergence of unauthorized collection centres and large accumulation of waste.

Ogwuche (2013) studied the spatial location of solid waste dumpsites and collection scheduling using Geographic Information Systems in Bauchi metropolis. The study revealed that while 40% of the solid wastes generated were managed by BASEPA, 30% were indiscriminately dumped in unauthorized spots and 20% were burnt. The open dumping of solid waste is a common practice in the metropolis and there are virtually few sites designated by BASEPA for collection. These dumpsites are located haphazardly without considering factors such as centrality, adequacy of space and other neighbouring land-uses. Burning produces a dangerous gas called 'dioxin' while the open dump serves as habitat for rats, snakes, other dangerous reptiles and animals in addition to the emission of offensive odour to the air.

In summary, the study by Nabegu and Mustapha (2015) though similar to this study was conducted in Kano not Bauchi and it was a desktop review. The study by Babanyara and Bogoro in 2011 focused mainly on solid waste evacuation, solid waste evacuation on the other hand is not BASEPA's only role in Municipal Solid Waste Management in the study area.Ogwuche (2013) focused on the spatial distribution of solid waste dumps and did not assess BASEPA.

So, in order to fill the above stated gaps in knowledge, this study evaluated the role of BASEPA in municipal solid waste management in Bauchi metropolis, addressing the following research questions:

1) To what extent has BASEPA achieved its mandate in the area of municipal solid waste management?

2) What is the perception of the public with respect to the role of BASEPA in municipal solid waste management in Bauchi town?

3) What are the public domain ways of increasing the effectiveness of the Bauchi State Environmental Protection Agency?

4) What are the major constraints to the existing municipal solid waste management practices in Bauchi town?

1.3 AIM AND OBJECTIVES

The aim of this study is to assess the effectiveness of the Bauchi State Environmental Protection Agency in Municipal Solid Waste Management in Bauchi metropolis. The objectives of this study are to;

i. examine the extent to which the Bauchi State Environmental Protection Agency has achieved its mandate in the area of municipal solid waste management in Bauchi metropolis.

ii. examine the perception of the public with respect to the role of the Bauchi State Environmental Protection Agency in municipal solid waste management in Bauchi metropolis.

iii. Identify public domain ways of increasing the effectiveness of the Bauchi State Environmental Protection Agency.

iv. identify the major policy/institutional constraints to effective municipal solid waste management in Bauchi metropolis.

1.4 SCOPE OF THE STUDY

The study covered the whole of metropolitan Bauchi i.e. an area of 32km radius.The twelve wards that constitute Bauchi metropolis (i.e. New GRA, Old GRA, Fadaman Mada, Yelwa, Dan Iya, Makama, Ibrahim Bako, Nassarawa, Dan Kade, Dawaki, Dan Amar and Hardo) formed the spatial units of the study.

The study assessed the effectiveness of the Bauchi State Environmental Protection Agency in managing municipal solid waste in Bauchi metropolis. Thus the contentscope of this study covered the mandate, public perception as well as the extent to which BASEPA has achieved its mandate in the area of municipal waste management as well as the constraints affecting the effective management of municipal solid waste in the study area.

The temporal scope is the six months period (starting from May to October, 2015) in which the data for this study was collected.

1.5JUSTIFICATION FOR THE STUDY

Urban waste management and by extension environmental planning and management represent some of the major challenges facing urban managers (Attahi, 1999).The problem has been linked directly with higher rates of urbanization in most parts of the world, especially Africa, Bauchi metropolis not being an exception. Undeniably, the rapid rate of urban growth is causing social and economic strains, some of which manifest themselves in environmental problems. These problems occur at varying spatial scales from the home through the neighbourhood, the city to the region.

Indeed waste, in whatever form, is an inevitable by-product of man’s socio-economic development process. What needs to be understood is that the sheer volume of waste does not

actually constitute the problem; it is the inability of governments and waste disposal firms to keep up with it (Onibokun, 2004). Apparently, in developing countries the problem is not as much to do with the quantity of waste, as it is to do with other factors such as poverty, attitude, and governance of the waste.

Achieving the MDGs goal seven (ensuring environmental sustainability) requires efforts in all aspects of the environment, with waste management playing a crucial role in this regards. Meanwhile, effective waste management and environmental protection programmes call for a clear definition of roles, jurisdictions, legal responsibilities and rights of the concerned governmental bodies and other organisations. The absence of clear jurisdiction may lead to controversies, ineffectiveness and/or inaction, undermining the politically sustainability of municipal solid waste management (MSWM) systems (Schubeler, 1996).

In view of the above and the fact that BASEPA is the sole agency saddled with the responsibility of legislating, planning and coordinating the management of municipal solid waste in Bauchi town (according to the Bauchi State Environmental Protection and Conservation Agency Edict No. 3 of 1997), the need to assess its role cannot be over emphasised. Also, it is hoped that the findings of this researchwould create more awarenesson municipal solid waste managementin order for planners, policy makers and the general public to evolve rational and sustainable policies/attitudes towards effective municipal solid waste management. The study can/will also serve as a reference material for further studies on Municipal Solid Waste Management and other related topics.

CHAPTER TWO

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1INTRODUCTION

This chapter examines key concepts and reviews relevant literature materials on Municipal Solid Waste Management.

2.2 CONCEPTUAL ISSUES

The key concepts discussed here are waste, solid waste, municipal solid waste, municipal solid waste management and the Bauchi State Environmental Protection Agency (BASEPA).

2.2.1 Waste

Waste refers to anything that is no longer serving a purpose i.e. something without value.Additionally, wastes are items which people are required to discard. However, according to Rushton (2010), one person's waste can become another person's valuable material, for example, milk packages may be used as fuel; leftover food may be fed to animals; discarded cardboard may serve as walls and roofs of thatch house (Maria and Schienberg, 1997).Due to changing technologies, availability and cost of input materials, the demand and need to use recovered waste is changing; waste can therefore be defined as something that nobody wants at a particular point in time and needs to be disposed of.

Wastes are typically classified as solid, liquid and gaseous which could be bio-degradable, semi-biodegradable and non-biodegradable. Based on land-use and practices in the human environment, there are five major sources of waste, namely, domestic/residential, commercial, agricultural, industrial and institutional wastes. Domestic /residential and

industrial wastes have the highest volume of wastes generated anywhere, anytime the world over (Ahmed, 2007).

2.2.2Municipal Solid Waste

Solid wastes according to Adedibu (1983) are non-liquid andnon-gaseous wastes resulting from a wide range of community, industrial, commercial and agricultural activities. Based on the sector of the economy responsible for generating them, Enger and Smith (2006) categorized solid waste into four broader kinds as mining, agricultural, industrial, and municipal solid waste.

Municipal solid wastes which are the focus of this study are wastes which are no longer needed by people because they are broke, spoiled, or have no longer use. Municipal solid wasteis defined to include refuse from households, non-hazardous solid waste from industrial, commercial and institutional establishments (including hospitals), market waste, yard waste and street sweepings. Semisolid wastes such as sludge and nightsoil are considered to be the responsibility of liquid waste management systems. While hazardous industrial and medical wastes are, by definition, not components of municipal solid waste, they are normally quite difficult to separate from municipal solid waste, particularly when their sources are small and scattered (Schubeler, 1996). Municipal solid waste can further be classified in different ways, vis-a-vis the point of origin of waste material, nature of material, kind of materials and heat contents of the materials.

Based on points of origin of the materials there are six types of municipal solid wastes namely: domestic waste, commercial waste, industrial waste, institutional waste, street sweepings and constructions and demolition wastes (Rand, Haukohl,Marxen, 2000). Based on the nature of waste materials Municipal Solid Waste can be classified as organic,

inorganic, combustible, putrescible and non-putrescible factions (Cornwell, 1998). Domestic waste or household waste derived from residential neighbourhoods constitutes 75% of all wastes (Habitat, 1993).

The composition of municipal waste varies greatly from country to country and changes significantly with time. In countries which have a developed recycling culture, the waste stream consists mainly of intractable wastes such as plastic film, and un-recyclable packaging. At the start of the 20th century, the majority of domestic waste (53%) in the UK consisted of coal ash from open fire. In developed countries without significant recycling it predominantly includes food wastes, yard wastes, containers and product packaging, and other miscellaneous wastes from residential, commercial, institutional, and industrial (United Nations Environmental Programme (UNEP), 2002).

2.2.3Municipal Solid Waste Management

Managementis a cyclical process of setting objectives, establishing long term plans, programming, budgeting, implementation, operation and maintenance, monitoring and evaluation, cost control, revision of objectivesand plans, and so forth. With respect to Municipal Solid Waste, Management involves the control of generation, storage, collection, transfer, transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations that is also responsive to public attitudes (Tchobanoglous, Theisen and Visil, 1993).

Municipal Solid Waste Management is thus defined as the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with the best practices of public health, economics & financial, engineering, administrative, legal and

environmental considerations (UNEP, 2004). Solid waste management has three main components: collection and transportation; reuse or recycling; and treatment or disposal. United State Environmental Protection Agency recommends using integrated, hierarchical approach to waste management with four components: source reduction, recycling, combustion, and land filling, to address the increasing volume of municipal solid waste. It ranks source reduction including reuse as the most preferred method, followed by recycling and composting, and lastly, disposal in combustion facilities and landfills (United State Environmental Protection Agency, 2002)

Municipal solid waste management (MSWM) is a complex task which depends as much upon organisation and cooperation between households, communities, private enterprises and municipal authorities as it does upon the selection and application of appropriate technical solutions for waste collection, transfer, recycling and disposal. All of these processes have to be carried out within existing legal and social guidelines that protect the public health and the environment and are aesthetically and economically acceptable. For the management process to be effective, various disciplines such as administration, finance, legal, architecture, planning, surveying and engineering have to work together (Schubeler, 1996).

Also, the following major issues must be considered in discussing the management of solid wastes; increasing waste quantities, wastes not reported in the national municipal waste totals, lack of clear definitions for solid waste management terms and functions, lack of quality data, clear definition of roles at the federal, state and local government levels,need for even and predictable enforcement regulations and standards and resolutionsof inter county, interstate and inter regional waste issues for municipal solid waste and its components (George and Frank 2002).

Overall goal of Municipal solid waste management is to collect, treat and dispose of solid wastes generated by all urban population groups in an environmentally and socially satisfactory manner using the most economical means available (Nabegu, 2008).

2.2.3.1 Goals and principles of municipal solid waste management

The goals of Municipal Solid Waste Management according to Schubeler 1996 are;

1. To protect environmental health: Municipal Solid Waste Management is to protect the health of the urban population, particularly that of low-income groups who suffer most from poor waste management.

2. To promote the quality of the urban environment:Municipal Solid Waste Management aims to promote environmental conditions by controlling pollution (including water, air, soil and cross media pollution) and ensure the sustainability of ecosystems in the urban region.

3. To support the efficiency and productivity of the economy:Municipal Solid Waste Management supports urban economic development by providing demanded waste management services and ensuring the efficient use and conservation of valuable materials and resource.

4. To generate employment and income: Municipal Solid Waste Management aims to generate employment and incomes in the sector itself.

To achieve the stated goals, it is necessary to establish sustainable systems of solid waste management which meet the needs of the entire urban population, including the poor. The essential condition of sustainability implies that waste management systems must be absorbedand carried by the societyand its local communities. These systems must, in other words, be appropriateto the particular circumstances and problems of the city and locality,

employing and developing the capacities of all stakeholders, including the households and communities requiring service, private sector enterprises and workers (both formal and informal), and government agencies at the local, regional and national levels. Waste management should be approached from the perspective of theentire cycle of material use, which includes production, distribution andconsumption as well as waste collection and disposal. Whilst immediatepriority must be given to effective collection and disposal, waste reductionand recycling should be pursued as equally important, longer-termobjectives. The principles of sustainable waste management strategies according to Schubeler (1996) arethus to

- minimise waste generation
- maximise waste recycling and reuse, and
- ensure the safe and environmentally sound disposal of waste.

Solid waste management goals cannot be achieved through isolated orsectorial approaches. Sustainable waste management depends on the overalleffectiveness and efficiency of urban management, and the capacity ofresponsible municipal authorities (Schubeler, 1996).

2.2.3.2 An overview of global municipal solid waste management practice

Historically, people have simply covered up the refuse of life with dirt, or dumped it where it was out of sight and out of mind. Through our activities we produce more waste than ever before without having enough space to put it, and so old habits are coming back to haunt us (Switzer, 1994). The emphasis has been on waste elimination, with little thought given to controlling the generation of waste (for example the use of attitudes, behaviour and income) during the first quarter of the twentieth century. The institution most directly connected to

production of waste process is the economic institution e.g. factories. Political institutions influence distribution of goods and services in society. Political and economic institutions are designed to increase rates of economic growth to support an increase of standard of living. Economic growth refers to an increase in the capacity of the economy to provide goods and services or final use (Cable and Cable, 1995).

Urbanisation leads to increased population densification and urban activities in cities generate a variety of forms of solid waste. These are produced according to the population need and the state of the economy. Growth of economy leads to increase in demand. This means that industries will produce more to meet market demand. In order to offer goods and services institutions like schools and hospitals need materials like papers, instruments and medicines. The moment these items are unusable they become refuse known as institutional waste. Commercial activities like banks, hotels, retail shops, restaurants and people in their homes generate domestic solid waste composed of elements mentioned above. This category is the mixture of the waste from goods andservices produced by institutions, commerce and industries.

In the past, dumping and burial have been the most used method to treatmunicipal waste because the generators were often unaware or unconcerned aboutthe potential effects of hazardous waste. Communities in the developed worldrealised that dumping and burial of waste could cause many problems and theydeveloped other techniques to treat and manage the waste. The most commontechniques were landfills, incineration, composting and recycling (Cable andCable, 1995).

All of the stated activities deal with the flow of waste and can take place at different stages of the waste management process For example waste can be recycled at the source and sold

from that point with the remaining waste being collected and transported directly to disposal. Alternatively, waste could be stored, collected, transported to a disposa1 site at which point reclamation could take place (Dawnarain, 2004).

The Municipal solid waste management process involves a range of activities which encompass: generation, collection and storage, transport, recycling, reclamation, reduction, sale of recovered resources, composting and disposal (Dawnarain, 2004).

a) Waste Generation:

Waste generation is central to the waste management process as it is the origin of waste. The key aspects of waste generation are:

- Source of waste generated
- Amount of waste generated
- Characteristics of waste generated and
- Waste reduction or minimization: waste reduction activities help to minimize the rate of waste generation. Waste reduction has various aspects:
    - Toxicity Reduction; the nature of waste is changed by reducing a manufacturer's use of toxic materials in consumer goods.
    - Volume Reduction; this involves the use of less material initially. For example by reduced packaging in consumer goods.
    - Production Changes; other methods of reducing waste include the production of goods that can be recycled more easily, such as changing

from multi-material packaging; redesign of products; and restriction on specific product types.

- Behavioural Changes; a number of economic factors can contribute to the reduction of waste; industries in the production of goods; individuals and commercial enterprises can use their purchasing power to create a demand for low waste products or items produced from recycled materials; governments can influence producers through economic or other incentives, and can influence consumers through education and information dissemination (Skinner, 1994).

b) Collection and storage of waste:

The collection of solid waste involves storage at the place of generation andtransport to the point of disposal. Collecting municipal waste costs three timesmore than disposal (Baum and Parker, 1973). The transport of refuse to disposalsites is done using vehicles ranging from tractors and trailers to compactor trucks.The collection of refuse is completed through the private contracts or themunicipal services. Many countries have been using a combination of manytechniques for collection and transport to the point of disposal and disposal itself.Success is possible if the producers of waste, the collectors, the equipmentoperators and the managers are educated or trained.

Storing waste properly is important to public health. After generating waste, the household is likely to either store or dispose of it immediately. Immediate disposal could take the form of burial or burning. Poor storage can attract vermin, encourage the spread of disease, hamper collection and in turn increase collection costs. The duration of refuse storage depends on the type of container used, storage capacity, climate and possibility of damage by animals. The

type of container used can also determine the type of collection. On site handling refers to activities associated with the management of solid waste until they are placed in the storage containers used for collection. Factors to consider when designing on-site waste storage and processing systems are: type of collection system; the economic radius of operation and on site processing methods to recover material. In the event of storage before collection or disposal, two basic storage options can be used: the separate unit storage and the communal storage unit (Fuggle and Rabbie, 1992). Storage is of primary importance because of aesthetic consideration (Tchobanoglous, Theisen and Eliason, 1977).

c) Waste Transfer/Transportation:

There are various types of transfer stations. The capacity requirements, materials handling system, vehicles, containers and the nature of the waste are important in the design of a transfer station. Transfer stations cut the haulage mileage considerably by eliminating the time the collection crew spends going and coming from the landfill. They reduce person power and equipment needs as well as fuel and maintenance costs. A transfer station also has another advantage in that if the landfil1 has to shut down temporarily, the station may be able to absorb the surge for a short time, and so collection can continue. Waste can be transferred in the following ways:

- In a one-level system, trucks dump onto a flat, concrete floor. Material is push loaded into a container, which uses a hydraulic ram to load trucks;
- In a two-level system, trucks dump onto a flat floor. The trash is then pushed to an open-top trailer, which is positioned on a lower level to receive the material. In a direct-dump system a collection truck dumps by gravity into a funnel shaper hopper. A big-top trailer is positioned under the hopper to receive the material; and

- A three-level (composition pit) system uses a dumping pip into which the trucks drop their loads. In this pit, a truck-type tractor or truck loader crushes the material before feeding it into the hopper. From there it goes into the trailer where the hydraulic excavator may be used to distribute the load. The compaction pit is not practical in transfer stations where big volumes make the additional machines economical (Habitat, 1993).

d) Processing/Recovery Methods:

On-site processing and the sorting of waste at source have the following goals: recovery of usable material; volume reduction; treatment of the waste in order to transform it so as to facilitate cheaper transport and disposal (e.g. processing and recovery – chemical, biological); isolation (fixation, encapsulation); destruction (incineration), and landfill (Fuggle and Rabbie, 1992). The processes are explained below;

i) Thermal Treatment; this consists of various methods of heat treatment of wastes and includes the following:

- Incinerationis the thermal destruction of waste. It has been used successfully in many European countries, and accepted as a disposal method. It is considered the most sanitary and economical method available as it produces minimal levels of visible emission and generates electricity as a by-product. It is also considered one of the most effective ways of dealing with hazardous wastes (Switzer, 1994). However, although European countries have used incineration but most waste is treated in landfills. In broad-spectrum incineration has not been used in developed countries. For example incineration was a failure in United States of America as the government could not convince the population and policy makers that it was

an effective disposal method. The incineration method was considered as a producer of gas and smoke emission because the waste was not completely burned when furnace temperatures were lowered to save on fuel consumption. These incinerators were built by inexperienced companies and could not upgrade the incineration at that time. The cities concerned with the air pollution began legislating against incineration because it was the source of pollution. The technology which could be used to increase the efficiency and reduce the pollution was available, but at a cost higher than disposal in sanitary landfill (Switzer, 1994).

Low-technology incineration is based on the controlled open dumping of smalldaily inputs (5-10 tons per day) at small waste-disposal sites.High-technology incineration; Uses purpose-built equipment such as double-chamber incinerators, rotary kilns, fluidized bed combustors, plasma arc furnaces or even mobile incinerators. The benefits of high technology incineration are the reduction of waste volumes (which conserves land filled space), the reduction in transport costs, and the destruction of intractable waste (Du Plessis and Nero, 1991). The disadvantages include the high costs of the incinerator and of Strictly controlled and monitored high-technology incineration may be environmentally safe but there is always the risk that a point source of pollution may be converted into a general source of pollution through stack fallout (Fuggle and Rabbie, 1992), Incineration has a place in waste management for the treatment of organic chemical wastes where the high costs associated with the process and its control is justified (Lubie, 1990).

ii) Pyrolysis of wastes involves the heating of waste material in an oxygen deficient atmosphere in order to convert the waste, by processes of thermal cracking and condensation, into gaseous, liquid, and solid fractions which may be used as energy sources (Fuggle and Rabbie, 1992).

iii) Isolation from the Environment this definition of the process is largely self-explanatory and includes a number of methods of dealing with intractable wastes that are not amenable to thermal treatment or physio-chemical methods. These include Encapsulation which involves the sealing of selected wastes in reinforced concrete. This method is currently used in South Africa to deal with wastes that cannot be landfil1ed e.g. hazardous medical waste (Fuggle and Rabbie, 1992). The method was specified by the Pollution Control Division of the Department of Water Affairs in co-operation with Waste-Tech. Encapsulation offers an alternative to incineration but is also relatively costly.

iv) Stabilization, solidification and chemical fixation of wastesInvolves the blenching of selected wastes with fly ash under high voltage e.g. explosives. The residue that becomes unreactive is then landfilled (Fuggle and Rabbie, 1992).

e) Recycling/Resource recovering:

Recycling refers to reuse of materials, a material is recycled if it is used, reused, or reclaimed. This traditionally involves the recovery of plastics, glass, paper, cardboard, metal and rubber from the waste stream.Recycling involves returning waste materials to the original process to substitute as a raw material, or to another process as input material (Polprasert, 1996; Switzer, 1994). Recycling occurs when materials from the waste stream are recovered and serve as "raw material" input for the manufacture of a new product. Hence, recycling is not

merely the separation of materials from the solid waste stream but occurs when such materials are incorporated into those products that enter the market place. The recycling process has two basic approaches. One is that recyclable materials are separated at the point of generation by the waste generator, and these materials are collected separately and transported to recycling markets. The second approach is to collect mixed wastes or co-mingled recyclable materials and separate them at a central processing facility. Recycling activity can take place at various stages, ranging at source (in this instance the household) through to pre-disposal, be it landfill or incineration (Fuggle and Rabbie, 1992).

Sometimes the word recovery is used to refer to the regeneration of valuable material that is considered to be useless for the previous owner.The recovery of these materials will achieve significant volume reduction (up to 30-40% of domestic waste), but should be economically viable and produce marketable goods. Recycling could help in reducing disposal cost or as a source of income. Recycling has been used successfully in developed countries because the education on environmental issue is advanced. For example, the United States of America, the National Environmental Protection Agency mission was to develop an environmental conscious and responsible public and inspire the individual to the sense of respect of the environment. It was its role to educate the youth and adult to increase environmental literacy (Onu, 2000). In Sweden, the waste disposal firms have extra responsibility of educating the consumers and producers to separate the waste and handle the waste in an environmentally friendly manner (Poswa, 2000).

f) Reclamation:

Reclamation of wastes can be distinguished from recycling in that materials, which are reclaimed from the waste stream, can have use or value without undergoing a process of

recycling. Reclamation can take place at source or just prior to disposal. Pickers on landfills are examples of agents who reclaim waste prior to disposal (Skinner, 1994).

Sale of Recovered Goods/Cost recovery:

Whilst this activity might seem out of place as an activity in the waste management process, its importance is worth noting in the light of the discussion on recycling. Without markets forrecovered or recycled goods, the activities of recycling and reclamation become redundant (Skinner, 1994).

The issue of cost recovery in solid waste management revolves around whether the service provided is regarded as a public or private service. The extent of various activities within the solid waste management framework of public services varies according to the type of service offered e.g. street cleaning as opposed to household collection; and level of service provided e.g. curb side versus communal collection (Skinner, 1994).

g) Composting/Biological Treatment/Bioremediation:

A rapidly growing field of research is bioremediation technology, initiated in the late eighties (Lawson and Alston, 1989). These include: composting (an-aerobic process). Composting is a form of recycling organic waste and includes: sewage and waste-water treatment, activated sludge, rotary biological contractors (aerobic and anaerobic), land farming (aerobic) e.g. petroleum wastes; clean ups e.g. oil spills, and contaminated ground water and landfill. As with other forms of recycling, this can take place at source, on the land of the householder, or in a composting plant prior to disposal (Lawson and Alston, 1989).

Composting is defined as a process for making humus out of heap of decomposing wastes (Goldstein, 1969). Composting is one of the techniques used to treat or manage municipal

wastes. Composting is also seen as a controlled treatment of garbage and other common wastes, so that hygienically safe end product is the result. Composting is used in developed countries; it is possible where recycling and waste sorting is applied. It is a process to be judged successful simply because it treats waste in a manner that destroys the dangerous germs and polluting agents in raw wastes. Composting is a process to return the waste into soil without polluting the environment. During composting the waste is stored in a pile with no odour, no smoke and no flies. It cost less compare with landfill. It also provides a natural resource. It is a good method because part of the waste is used for maintaining the fertility level of the soil. The composting is the alternative method to landfill (Dawnarain, 2004).

h) Disposal and landfills:

Disposal of waste can take place in a controlled or uncontrolled manner. Uncontrolled disposal could take the form of dumping of waste, open burning of waste or burying of waste but all these methods cause a lot of environmental problems. Controlled disposal of waste usually takes place by means of sanitary landfilling.Sanitary landfills came about as a result of the need by communities to avoid the problems associated with uncontrolled disposal. Landfill-based disposal is currently the most cost-effective method and still appears to be the most forgiving of all the established disposal methods (Knox, 1988). A landfill that is well designed and managed can operate with minimal adverse environmental impacts and, as a bioreactor, can produce utilizable landfill gas. Thus, it is inherently the most appropriate method for a developing economy. A sanitary landfill is not a dumpsite. It is a scientifically selected, designed, engineered and managed refuse-disposal operation where the daily input of waste is spread, compacted and covered with soil to a pre-planned development programme. The development programme specifies the types of waste that are acceptable and

those that are unacceptable to the site and also the way in which the site will be managed (Dawnarain, 2004).

During the decomposition of waste landfill produces leachate and vents flammable methane gas that could cause health risk (Switzer, 1994). It can be an advantage if the landfills are regulated because that gas can be recovered and distributed to communities for re-use, or to generate electricity. The practice of landfill is declining because of lack of land, and also because of more restrictive criteria used to decide where to open a landfill site. Historically, the criterion for selection of landfill was accessibility, but nowadays the health risks which can be caused by the landfill are taken into consideration. The site is accepted only after a lot of studies. Landfill is becoming very expensive because of scarcity of land and the increase of municipal waste and the long distance it must be transported to the site. That is the reason why the policy makers are proposing to encourage the use of recycling and waste recovery and composting techniques.

2.2.3.3 Personalities associated with municipal solid waste management

A wide range of individuals, groups and organisations are concerned with Municipal Solid Waste Management as service users, service providers, intermediaries and/or regulators. The interests, agendas and roles of these actors are briefly described below:

Households, Communities and other Service Users:

Residential households are mainly interested in receiving effective and dependable waste collection service at a reasonably low price. Disposal is not normally a priority demand of service users, so long as the quality of their own living environment is not affected by dump sites. Only as informed and aware citizens do people become concerned with the broader

objective of environmentally sound waste disposal. In low-income residential areas where most services are unsatisfactory, residents normally give priority to water supply, electricity, roads, drains and sanitary services. Solid waste is commonly dumped onto nearby open sites, along main roads or railroad tracks, or into drains and waterways. Pressure to improve solid waste collection arises as other services become available and awareness mounts regarding the environmental and health impacts of poor waste collection service. Poorly served residents often form community-based organisations (CBO) to upgrade local environmental conditions, improve services and/or petition the government for service improvements. CBOs which may arise in middle and upper income neighbourhoods as well as in low-income areas may become valuable partners of the government in local waste management. When sufficiently organised, community groups have considerablepotential for managing and financing local collection services and operating waste recovery and composting activities (Schubeler, 1996).

Other service users including small and large scale industrial and commercial establishments and institutions are similarly interested in reliable and affordable waste collection service (Schubeler, 1996).

a) Non-Governmental Organisations:

Non-governmental organisations (NGOs) operate between the private and governmental realms. Originating outside of the communities in which they work, NGOs are motivated primarily by humanitarian and/or developmental concerns rather than an interest in service improvement for their own members. The self-creation of meaningful employment for members may also be a motivation for NGO formation. NGOs may help increase the capacity

of people or community groups to play an active role in local solid waste management by contributing to:

- people's awareness of waste management problems,
- organisational capacity and the formation of community-based organisations(CBO),
- channels of communication between CBO and government authorities,
- CBO's voice in municipal planning and implementation processes,
- technical know-how of locally active CBO, and
- Access to credit facilities.

NGOs may also provide important support to informal sector waste workers and enterprises, assisting them to organise themselves, to improvetheir working conditions and facilities, increase their earnings and extend their access to essential social services such as health care and schooling for children (Schuebeler, 1996)

b) Local Government:

Local government authorities are generally responsible for the provision of solid waste collection and disposal services. They become the legal owner of waste once it is collected or put out for collection. Responsibility for waste management is usually specified in bylaws and regulations and may be derived, more generally, from policy goals regarding environmental health and protection. Besides their legal obligations, local governments are normally motivated by political interests. User satisfaction with provided services, approval of higher government authorities and financial viability of the operation are important criteria forsuccessful solid waste management from the local government perspective. The authority

to enforce bylaws and regulations, and to mobilise the resources required for solid waste management is, in principle, conferred upon local governments by higher government authorities (Schuebeler, 1996).

c) National Government:

National governments are responsible for establishing the institutional and legal framework for MSWM and ensuring that local governments have the necessary authority, powers and capacities for effective solid waste management. In many countries, responsibility is delegated without adequate support to capacity building at the local government level. To assist local governments to execute their MSWM duties, national governments need to provide them with guidelines and/or capacity-building measures in the fields of administration, financial management, technical systems and environmental protection. In addition, national government intervention is often required to solve cross-jurisdictional issues between local government bodies, and to establish appropriate forms of association when as in most metropolitan areas effective wastemanagement calls for the collaboration of several local bodies (Schuebeler, 1996).

d) Private Sector Enterprises:

The formal private sector includes a wide range of enterprise types, varying from informal micro-enterprises to large business establishments. As potential service suppliers, private enterprises are primarily interested in earning a return on their investment by selling waste, collection, transfer, treatment, recycling and/or disposal services. Operating in various forms of partnership with the public sector, they may provide capital, management and

organisational capacity, labour and/or technical skills. Due to their profit orientation, private enterprises can, under appropriate conditions, provide MSWM services more effectively and at lower costs than the public sector. However, private sector involvement does not, in itself, guarantee effectiveness and low costs. Problems arise when privatisation is poorly conceived and regulated and, in particular, when competition between suppliers is lacking.

Private sector waste collectors may be contracted directly by individual households, neighbourhood associations or business establishments. More often, they operate under contractual agreement with municipal authorities. In this case, the authorities commonly retain responsibility for user fee collection. This arrangement ensures more equitable service access; when private enterprises depend on the direct collection of user charges. They have little incentive to provide services in low-income areas where revenue potentials are weak (Schuebeler, 1996)

e) Informal Private Sector

The informal private sector comprises unregistered, unregulated activities carried out by individuals, families, groups or small enterprises. The basic motivation is self-organised revenue generation; informal waste workers are often driven to work as waste collectors or scavengers by poverty and the absence of more attractive employment possibilities. In some cases, informal waste workers belong to religious, caste or ethnic minorities and social discrimination is a factor which obliges them to work under completely unhygienic conditions as waste collectors or sweepers. Their association with an activity which the public perceives to be filth-related tends, at the same time, to perpetuate discrimination against them. Informal waste workers usually live and work under extremely precarious conditions. Scavenging, in particular, requires very long working hours and is often

associated with homelessness. Besides social marginalisation, waste workers and their families are subject to economic insecurity, health hazards, lack of access to normal social services such as health care and schooling for children, and the absence of any form of social security.

The waste collection, transfer, separation, recycling and/or disposal activities of informal waste workers constitute economically valuable services. Informal waste workers work, normally, on a self-employed basis or as informally organised groups; in some cases they may be hired directly by households and/or neighbourhood groups (Schuebeler, 1996).

f) External Support Agencies:

Numerous bilateral and multilateral external support agencies (ESAs) are engaged in supporting MSWM in low-income countries. While some ESAs have acquired considerable expertise in the area of waste management, MSWM is often a component within a broader development programme aimed at improving urban management capacities and/or urban environmental protection (Schuebeler, 1996).

2.2.4 Bauchi State Environmental Protection Agency (BASEPA)

The Bauchi state Environmental protection Agency known by its acronym as BASEPA is the sole agency responsible for all matters relating to environmental protection, sanitation, environmental research and policy in Bauchi State. It was established by edict No. 3 of 1997 and came into existence on 10th June, 1997.

The establishment of BASEPA traces its origin to the involvement of Nigeria in the global commitment to tackling the global environmental problems as typified in the "Earth Summit" held in June, 1992 in Rio de Janeiro, Brazil. In the said summit, world head of states and

governments met to forge a common approach in solving world environmental problems and achieving a global sustainable development.

Nigeria having committed internationally to achieving a sustainable development based on positive management of the environment promulgated Decree 58 of 1998, establishing a Federal Environmental Protection Agency (FEPA). FEPA was saddled with the sole responsibility of protecting Nigerian environment as well as implementing Nigeria's International commitments on Environmental protection. Furthermore, a National Council on Environment composed of all state commissioners responsible for environment was established as an advisory as well as a policy making body on environment. This national council on environment directed the establishment of its replica at the state level with similar responsibilities – thus the establishment of the state committee on environment

Thus, conscious of the positive values of a healthy environment in realisation of the delicate ecological balance in Bauchi State, the state government then directed the state committee on environment to propose a body that will be responsible for environmental protection in the state. Hence, the establishment of BASEPA.

The mission statement of BASEPA is:

"*To employ sound environmental management principles and practices and to initiate appropriate management programs, policies and legislations in partnership with relevant stakeholders (National and International) for sustainable development*".

A mandate is an official order or authority to carry out a policy or course of action, it is also known as a decree, edict, commission or injunction. Thus, the mandate of BASEPA with respect to MSWM in Bauchi metropolis is enshrined in the edict No. 3 of 1997. Under the

said edict, BASEPA is the sole agency responsible for all matters relating to environmental protection, sanitation and environmental research and policy.

Section 9 (5) of BASEPA edict specifically state the function of the agency with respect to MSWM thus; notwithstanding the provision of any law , the agency shall regulate, direct and control the throwing, dumping or disposal of refuse negligently in the whole state.

As the custodian of the environment in the whole state, BASEPA is responsible for the management of solid waste in residential and commercial areas. However, according to the management of BASEPA, as revealed in the interview, the Abubakar Tafawa Balewa University and the state specialist hospital waste management responsibilities are not under the jurisdiction of BASEPA.

Section 10 of the edict deals with the powers of the agency, with respect to MSWM, subsection 5 states that, the agency can enter into agreement with any public or private organisation and individuals to develop, utilise, coordinate and share environmental monitoring programmes and biological effects of various activities on the environment.

Usman and Mohammed (2012) stated that solid waste management in Bauchi metropolis is handled by both formal and informal sectors; thus:

i) BASEPA: is responsible for monitoring and regulating the activities of the private companies as well as collection and disposing of heap of refuse, street sweeping, managing landfills/ dump sites, establishment of performance standards and enforcing waste management regulations.

ii) Cosmopolitan Cleaners: a private waste collection company is responsible for street cleaning and collection of waste dumps at the streets every day. The operation is usually along the

dual carriage ways in the metropolis which consist of the high density areas. People dump their waste every morning at street and road sides. Compactor truck with its crew members usually four to five in number collect the refuse using shovels and load it on the compactor trucks for transport to the dumping sites as shown in Plate I.



Plate I: Cosmopolitan workers evacuating solid waste on the streets in Bauchi Metropolis

Source: Field work, 2015

iii) The National Union of Road Transport Workers (NURTW) – the tipper branch of this organisation collects waste at various dump sites designated by the authorities or illegal dump sites such as vacant plots, uncompleted building, public buildings and public drains. The operation is usually once or twice a week. Collection is done by pay loader into the tippers for transport to the final dump sites.

IV) The Community Based Organizations (CBOs): prominent in waste management activities in Bauchi metropolis are the Bauchi Youth Forum, Mahema, Community Rescue Initiative,

and Women Initiative for Change and Gwallaga Youth Forum. These organisations carry out their sanitation services at monthly intervals and usually involve evacuation of waste and public drains clearance.

Other Private Operators; registered and unregistered operate within the low density areas like G.R.A and housing estates. They render their services for a fee. Collection of waste by these operators is usually done weekly and is achieved with the use of open dumps/waste bins stationed at individual premises that required their services. Most prominent of these operators are Top town cleaners, Ken-Hedges, Talatu Ventures, Naz environmental cleaners etc.

Also, section 10 (16) grants the agency the power to do anything possible and necessary to carry out its functions. In addition to what is being done now to manage solid waste, the agency according to the interview conducted with the management staff, has future ambitions of;

i. Collaborating with private waste companies on a larger and more effective scheme in the area of waste evacuation, final disposal.

ii. Constructing modern and standard landfills for the disposal of waste.

iii. Generating revenue from private waste evacuation companies in the form of levies to be paid annually.

iv. Waste to wealth training: this work understands that, it will be a kind of training scheme on the various techniques/methods of recycling of solid waste materials.

v. Introducing jail terms and stiffer penalties such as levies for waste offenders

vi. Obtaining full control of the state recycling plant in order to streamline and robustly carry out recycling activities e.g. pyrolysis. The state has a recycling plant but currently it is not under the management of BASEPA.

vii. Re introducing state-wide sanitation day(s).

viii. Acquiring modern waste management equipment like pay loaders, compactors, street sweepers, etc. in order to enhance and make easy the processes of waste management in the state.

ix. Media jingles and awareness campaigns on the importance of proper waste management and the consequences of waste mismanagement

x. Providing additional temporary collection centres to augment the lingering problem of waste dumping on streets, drainages and other illegal places.

Hopefully, if the above plans are implemented, the vision of BASEPA which is "Committed to creating an effective environmental system, planning, design and control through provision of clean and healthy environment for sustainable development in Bauchi state" will be fully achieved.

2.2.4.1 Statutory Responsibilities of BASEPA

On establishment, the goal of the state policy on environment was to achieve sustainable development in Bauchi state particularly to;

a) Secure for all residents a quality environment adequate for their health and well being

b) Conserve and use the environment and Natural resources thereof for the benefit of present and future generations

c) Restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of renewable natural resources and ecosystems

d) Raise public awareness and promote understanding of essential linkages between environment and development and to encourage individuals and community participation in environmental efforts

e) Cooperate with other state and federal organisation/agencies to achieve optimal use of Trans boundary natural resources exploitation and effective prevention or abatement of Trans boundary environmental pollution.

According to the edict, the functions of BASEPA are;

i. Implement environmental policies towards protection, sustenance and development of the environment generally.

ii. Identify, detect and monitor any environmental problems and evolve solutions thereto particularly those related but not limited to desertification, gully erosion, water contamination, wastes of various kinds, soil degradation, vectors, pest rodents, reptiles, noise that constitute nuisance, sewerage, bush burning, indiscriminate felling of trees, stray and wandering animals, mining and other excavations, protection of wild life and their habitat, offensive trades and surface and underground waters.

iii. Represent the state in any matters pertaining to plans, procedures or negotiations for government arrangement relating to the environment.

iv. It is also the function of the agency to arrange and co-ordinate planning for the urban and regional process in the state and or to liaise with private or public institution that engage in environmental activities.

v. Notwithstanding the provision of any law they agency shall regulate, direct and control the throwing, dumping or disposal of refuse negligently in the whole state.

vi. The agency shall also ensure the removal, destruction and or demolition of any stalls, shop, shed or any unauthorised structures from streets, high way nor other open places.

Subject to the edict, the agency has the powers of entering into contract with any person for the purpose of executing its responsibilities and functions.

2.2.4.2 Organisational Structure of BASEPA

Figure 2.1 shows the organisational chart of BASEPA

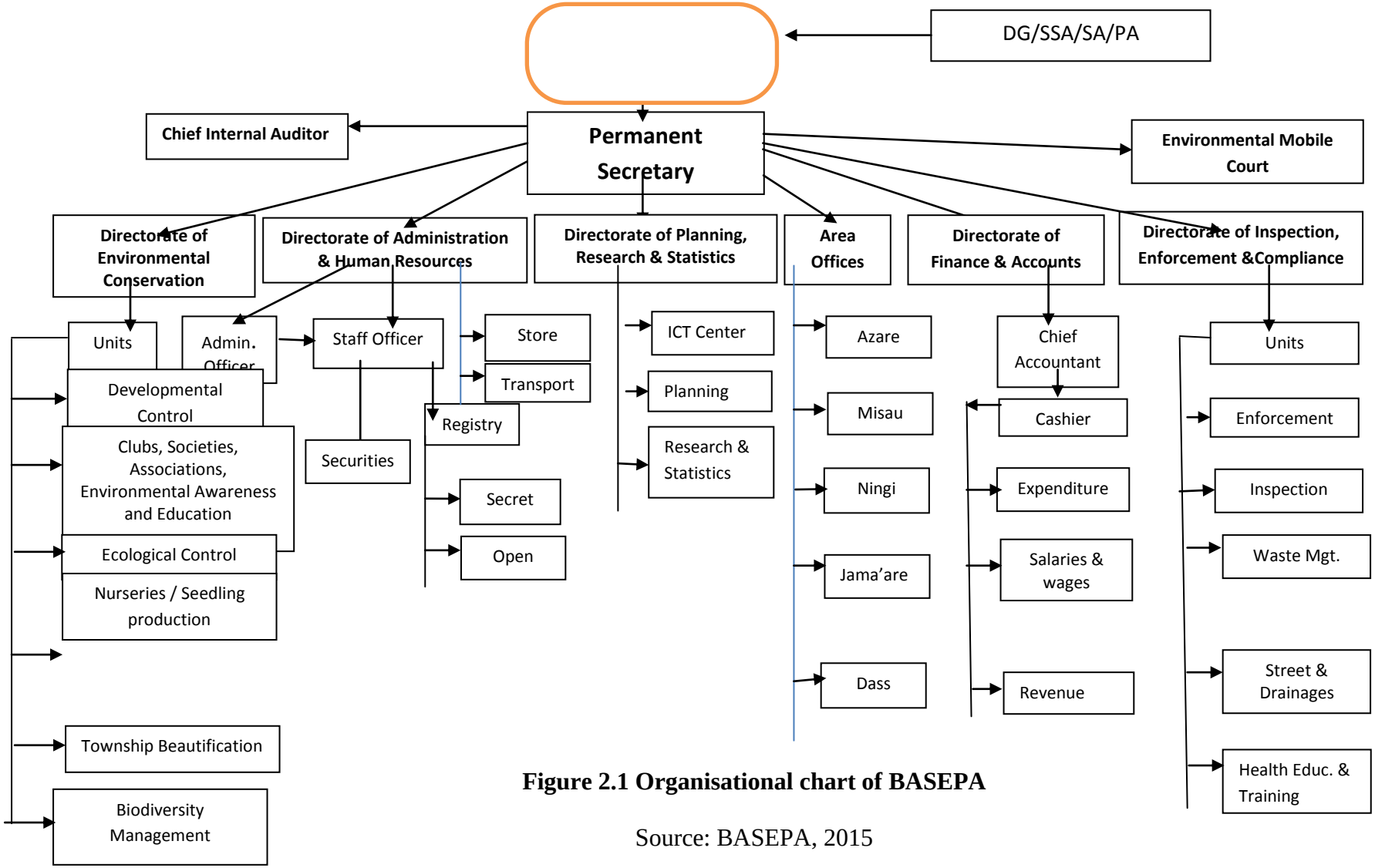


Figure 2.1 Organisational chart of BASEPA

Source: BASEPA, 2015

As shown in Figure 2.1, BASEPA is governed by a board of directors. According to section 39 of the edict establishing it, the membership of the board of directors should;

a. Have a part time chairman who shall be a person with sound knowledge of environment, natural resources conservation or related discipline.

b. Have one representative each of the ministries of works, housing and land development, health and human services, agriculture and natural resources and commerce and industries.

c. Have a person of proven integrity

d. The director general of the agency.

e. Have other members as may be required by the military administrator as the situation warrants.

It should be noted that currently, the Director General is referred to as the Permanent Secretary. Also, the government is now a civilian one.

The board of directors' main function is to formulate policy and policy matters in respect of environmental protection/ conservation and to make rules and regulations for the affairs of the agency. The board however, "shall not engage in the day to day management of the agency" as stated in the edict.

After the board of directors, comes the Permanent Secretary who is referred to as the Director General hitherto. He/she is the chief executive officer of the agency and thus responsible for the day to day running of the agency

The agency has five directorates and each is headed by a director as stated in section 8(b) of the edict. The directorate in charge of waste management is theDirectorate of InspectionEnforcement and Compliance. Under this directorate also are the enforcement, inspection, street & drainages and Health Education & Training units. All these units serve to monitor, regulate and ensure proper waste management.

The agency has an internal auditor and operates an Environmental mobile court to deal with defaulters and judge issues bordering on the environment. Lastly, the agency has area offices in five local government headquarters of the state. The area offices are responsible each for three to four local government areas.

2.2.4.3 Funding of BASEPA

According to section 11 of the edict, BASEPA can source for funds from among the followingsources;

a. Budgetary grant by the state government;

b. Money received and collected as gift, assistance, loan or grant from other sources;

c. Money raised from subscription, fine or any activities of the agency in its day to day management.

2.2.4.5 Machinery and Plant of BASEPA

In addition to the machinery and plant listed in Tables 2.1, the agency has two tractors, about fifteen lawn mowers, 2 tractor mounted slashers and about 50 Roll on Roll of (RORO) waste containers situated at various locations in the metropolis.

Table 2.1 Machinery and plant use in MSWMby BASEPA

S/N	Machinery Type	Number Available
1.	Waste Compacting Vehicle	Four
2.	Tipper	Two
3.	Pick – up	Three
4.	Motorcycle	Three
5.	Pay loader	One

Source: BASEPA, 2015

2.2.4.6 Staff of BASEPA

According to section 40 of the edict, "the agency shall have all categories of workers to assist in making it function well……." As at March, 2015, the staff strength of BASEPA was six hundred and sixty (660). The health attendants constitute the cadre with the highest number of staff (229), environmental management had six, environmental health technicians and assistants combined had fifty, community health extension and assistant workers (CHEW and CHA) were ten in number, etc.

2.3 LITERATURE REVIEW

This section reviews literature materials onthelaws and institutions guiding municipal solid waste management, the practices, perceptions, attitudes as well as the problemsof municipal solid waste management.

2.3.1Laws and Institutions Guiding Municipal Solid Waste Management

In Nigeria, government has over the years enacted laws and established agencies in order to regulate and guide the management of solid waste in the country. Under the current constitutional arrangement in Nigeria, issues relating to environmental management including

waste management fall under the Exclusive, Concurrent and Residual lists, i.e., all tiers of governments – Federal, State and Local authorities can legislate. Accordingly, the Federal government has enacted several laws, such as: Petroleum Decree 1969, Territorial Water Decree 1967, Explosive Act 1964, Federal Environmental Protection Agency Decree 58 of 1989, Harmful Waste (Special Criminal provision) Decree No. 42 of 1988, Natural environmental protection (pollution abatement in industries and facilities generating wastes regulation, 1991, Environmental impact Assessment Decree No. 86 of 1992, National Environmental (Sanitation and Wastes Control) Regulations of 2009 , Several other regulations provided to enforce compliance with the requirement of sustainable standard of Environmental sanitation (Nabegu 2008).Legislations at the State level amongst others include Lagos State Waste Management Authority (LAWMA), Oyo State Solid Waste Management, Kano State Refuse Management and Sanitation Board (REMASAB), Kaduna State Environmental Protection Authority Law (KASEPA), Rivers State Environmental Sanitation Authority and the Bauchi State Environmental protection Agency (BASEPA).

According to Dawnarain (2004), the Bill of Rights, Section 24 (2) of the Constitution of the Republicof South Africa (Act l08, 1996) contains a number of rights relevant to integrated pollution andwaste management. Any particular Act or statutory provision that does not uphold these rights isunconstitutional. The Constitution also provides the legal basis for allocating powers to differentspheres of government, and is thus relevant to the institutional regulation of integrated pollutionand waste management.The most pertinent fundamental right in the context of integrated pollution and wastemanagement is the Environmental Right, Section 24 (2) of the Constitution of the Republic of South Africa (Act l08, 1996)), which provides that: Everyone has the right to an environment that is not harmful to their health or well-being; andto have the environment protected, for the benefit of present and

futuregenerations through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; andsecure ecologically sustainable development and the use of naturalresources while promoting justifiable economic and social development.This section of the Bill of Rights specifically imposes a duty on the State to promulgatelegislation and take other steps to ensure that the right is upheld and that, among other things,pollution and ecological degradation are prevented. To date, a number of steps have been takento ensure this environmental right, including the publication of the White Paper onEnvironmental Management Policy for South Africa, the publication of the WhitePaper on Integrated Pollution and Waste Management (DEAT, 2000), the promulgation of theNational Water Act (1998) and the National Environmental Management Act (1998), and thedevelopment of a National Waste Management Strategy.

Attahi (2012), examined the institutional linkages and responses to the solid waste management problem in the Shama-Ahanta-East Metropolis, Ghana. The study employed a qualitative research approach in the collection and analysis of data. The study established that, waste management in Ghana is generally the responsibility of the Ministry of Local Government, Rural Development and Environment, which supervises the decentralized Metropolitan, Municipal and District Assemblies (MMDAs). However, regulatory authority is vested in the Environmental Protection Agency (EPA), which is entrusted with the responsibility for setting environmental quality standards and ensuring their enforcement. The Assemblies are responsible for the collection and final disposal of solid waste through their Waste Management and Environmental Health and Sanitation Departments. According to 1992 Fourth Republican Constitution of Ghana, the Local Government Act 462 of 1993 and the Environmental and Sanitation Policy of 1999, the Assemblies are supposed to enact bye-laws regulating the management of waste in their areas of jurisdiction. Furthermore, the

Assemblies are to strengthen their local unit committees through the Assembly Members in order to protect and manage their respective environments.

Nabegu (2008) assessed the Kano State Refuse Management and Sanitation Board (REMASAB. Questionnaire and interview were used to obtained data for the study. The study revealed that the Refuse Management and Sanitation Board (REMASAB) is the institution responsible for MSWM in Kano state. The law establishing the agency was contained in the Kano State Gazette No.7 Vol. 35 dated in November, 2003 as law No.7.Section 4(1),the law establishing the Board specifically enumerated the following functions: Refuse collection and disposal, management of refuse collection centers and dump sites, land reclamation, street sweeping and cleaning, control of street hawking and random refuse disposal, Liaise with self-help group in relation to waste collection and disposal, Inspection and enlightenment programs on sanitation, liaise with all metropolitan local governments towards a sustainable sanitation operation.

A study by Nabegu and Mustapha (2015) on the institutional constraints to MSWM in Kano metropolis revealed that, the present set up in Nigeria, virtually every state of the federation has a waste management agency with its enabling laws, resulting in a situation where the agencies created by various local authorities, states and the Federal Government pursue their respective agenda with unclear and conflicting roles i.e. they are both often providers of service and regulators (they combine service delivery and regulatory functions). The study went further to state that under the current institutional and regulatory framework, Kano metropolis and indeed all urban centres in Nigeria lack a comprehensive policy in the form of institutional structures, functional strategies, systems for inter-sectoral coordination and tariff setting for waste management.

2.3.2 Municipal Solid Waste Management Practices, Perceptions and Attitudes

Waste management in any city is of paramount importance due to the risk posed to human beings and to the environment. Encarta Dictionary, 2008 describes it as the activities that deal with waste before and after it is produced, including its minimization, transfer, storage, separation/sorting/segregation, recovery, recycling, and final disposal.

Babanyara and Bogoro (2011) studied solid waste evacuation in Bauchi metropolisemploying questionnaire, interview and observation methods to gather data. The studyrevealed that at the time of the survey, BASEPA was the only authority carrying out solid waste collectionand disposal,the agency evacuates 68.70% (192.5m3) of 280.20m3 of the solid waste generated daily, the remaining 31.30% is not collected, as such heaps of solid waste continue to accumulate. 75.30% of the respondents were willing to pay some charges to improve refuse collection. The study discovered that the agency had only two disposal sites: one along Bauchi-Gomberoad about 5km from the town, the other is located 500m behind Federal Secretariat, boththe sites are landfill sites. BASEPA used the community depot system for collection and disposal of thewaste generated and the collection centres are few (about 86 in the whole metropolis), Up to 30% of the respondents did not have storage facilities and this lapse according to the study can be attributed to lack of supervision and enforcement of environmentallaws by the agency.

Nshimirimana (2004) studied the attitudes and behaviour of low-income households towards the management of Domestic Solid Waste in Tafelsig,Mitchell's plain. The study revealed that 99.2% of the sampledpopulation are aware that waste collection takes place once a week in the city;the majority of the respondents (97.6%) place their dirt bin on the pavement in front of their houses. If the dirt bins are placed far away from thepavement, the waste

collectors cannot see them;In terms of satisfaction with the system of waste collection used in the city,46.3% of respondents are satisfied with the present waste collection in the household areas;The majority of respondents (98.4%) said that they are disturbed to see people throwing waste on their neighbour's property and also in the area in general;The majority of people in the city are satisfied with waste collectors' performance and behavior while 48% of the respondents present a very low level of concern about waste management. On the question of attitudes to illegal dumping, 43.9% indicated that they will report to the authority any person they see dumping solid wastein open space area near their residences. Overall, the study indicated that socioeconomic factors have contributed to the mismanagement of domestic solid waste.Poor domestic solid waste management is also due to the lack of awareness andtechnical and manpower problems. The role of local authorities in wastemanagement seems to be invisible in the area. The lack of communicationbetween the councilors and the City's community is a barrier to publicinvolvement in policymaking.

Ogwuche (2013) studied thespatiallocation of solid waste dumpsites and collection scheduling using the geographic information systems in Bauchi metropolis, Nigeriaand discovered that four main methods are used for the disposal of solid wastes in the metropolis. These methods and the percentage of solid wastes they take care of according to the study were BASEPA (40%), open dumps (30%), burning (20%) and private pay service (10%). The study also found out that open dumping of solid waste is a common practice in the metropolis because there are virtually few designated sites for BASEPA collection.These dumpsites are located haphazardly without considering factors such as centrality, adequacy of space, other neighboring land-uses, etc. The practice is also indiscriminately carried out at various locations in the municipality. The study recommended that integrated solid waste

management be introduced in order to achieve sustainable solid waste management in urban areas.

In another study by Babalola, Ishaku, Busu and Majid (2010) on the Practice and Challenges of Solid WasteManagement in Damaturu, Yobe State, Nigeria, it was revealed that the collection of waste in Damaturu is carriedout by the Yobe State Environmental Protection Agency, (YOSEPA), the system adopted by YOSEPA is the public bin collection system. This comprises of the collection fromdifferent sources like residential and commercial areasand deposited in the public bins located strategicallyalong street corners of the town. Wastes are not treatedbefore disposal at the final dumping sites. Waste minimizationand recycling has not gone beyond the practiceof picking and sorting through heaps of refuse or garbage.The analysis of waste collected shows that there was adecrease in the amount of waste collected from 23107tons in 2003 to 11466 tons in 2009 during the period underreview. This according to the study, has led to loss of aesthetic in theurban landscape.

Gani, Chiroma and Gana (2012) conducted a research on Women and Solid Waste Segregation in Bauchi, Nigeria.The major instruments used for data collection were questionnaire, interview and direct measurement of household solid waste at source. According to the study, every household is supposed to have a container for temporary storage of the solid waste generated in the house and fromthe survey it was discovered that more than 90% of the households have storage containers. Most of the households inthe metropolis have only one container (dust bin) for temporary storage of all the solid waste generated in the house, only10% has more than one storage container. According to the study, with only one solid waste storage container it couldbe impossible for household to segregate the solid waste generated.The respondents have different reasons for not

participating in solid waste segregation: up to 67.8% claimed that it wasbecause they have only one container, 21.9% claimed they did not have time and the rest did not see the need forsegregation or did not have space for storing solid waste. The respondents gave an encouraging response regarding theirwillingness to segregate their solid waste at the household level. As high as 89.5% indicated their willingness to partake in the segregation.

Dawnarain (2004) investigated solid waste management practices in Chatsworth Township, metropolitan Durban - Kwazulu-natal.A survey assessment was conducted by means of a questionnaire, also,the study was complemented with semi-structuredinterviews with specific people of interest. The study revealed that 40% of the households disposed food, garden and sanitary wastes in the refuse bins,only 28%of respondents practiced recycling.74% were of the opinion that residents were the main contributors of littering and felt that this practice wasunacceptable. About70% of respondents were of the view that it was the duty of the municipality to stop residents from illegal dumping. The study also indicated that illegal dumping was a major concern as opined by 75% of the respondents. More than half of the respondents indicated that strict laws and fines should be enforced, waste collection days should be increased to twice weekly, promotion of education (awareness programs, extensive media coverage, environmental campaigns and clean-ups), municipality to clean up open spaces and regular street clean-ups, provision of more bin bags for household waste collection, offenders should be reported, placement of skip, recycling domes at strategic points, acommunity watch should be set up in the neighbourhood and the municipality shouldcollect garden waste once monthly at no cost to householders. Thefindings also revealed that 94% are willing to separate their household waste and participate in waste recycling programs. Majority of respondents (89%) did not know of any committees that dealt with environmental problems, majority of respondents (92%) have not mobilized to deal

with the solid waste problem in their area. Only 52% of respondents forwarded a positive response on the issue of the waste management system and stated that it was adequate.

In conclusion, Ogwuche (2013) stated that, for a sustainable solid waste management (The United Nations World Commission on Environment and Development defines sustainable development as that which meets the needs of the present without compromising the ability of futuregenerations to meet their own needs) in urban areas is to be achieved, integrated solid waste management should be adopted. The objective of an Integrated Waste Management Strategy (IWMS) is to minimise impact on the environment by employing all possible waste management technologies. An integrated Waste Management plan follows the life cycle of consumer products from cradle to grave, seeking to maximise the useful life of the resources (Tammemagi, 1999). The techniques of Integrated Waste Management are: waste minimisation (or source/ waste reduction). Composting (and culture), recycling (including re-use) and disposal (incineration and landfill). The above techniques are termed "integrated" as it is important to promote all options in tandem because not all waste can be composted, and recycling in isolation cannot deal with all waste generated.

2.3.3 Problems of Municipal Solid Waste Management

According to Ogwueleka (2009),Municipal solid waste management has emerged as one of the greatest challenge facing environmental protection agencies in developing countries.Problems of urban waste management in the developed and developing worlds are different. While developed countries generate larger amounts of wastes, they have developed adequate facilities, competent government institutions and bureaucracies to manage their wastes, developing countries like Nigeria are still in the transition towards better waste

management hence, they currently have insufficient collection and improper disposal processes of wastes.

A study on the obstacles and prospects of solid waste management in Bauchi metropolis byUsman and Mohammed (2012) revealed that inadequate enlightenment of the public on the need to properly dispose of their waste and the attendant health implications of doing the contrary, Lack of proper dumping sites, collection points and transportation, Insufficient funds to cater for waste evacuation in newly developed and developing urban fringes were some of the problems of MSWM in the metropolis. In addition to these factors, the research also identified a very vital factor thataffects solid waste management in Bauchi metropolis i.e. the ambiguity in the Nigerian Environmental law on the authority (i.e. state government or local council) vested with the responsibility of collecting and disposing of waste in the states.

Chukwuemeka,Ugwu and Igwegbe (2012) conducted a study on management and development implications of solid waste management in Nigeria. The study was carried out to evaluate the chains of problems militating againstsolid waste management in Nigeria with particular interest on Enugu State. The study adopted survey researchmethod. Data collected through questionnaire were analyzed and hypotheses tested using Z-test statistical measure.The study revealed that, resources available for solid wastemanagement are much less to make any impact,this according to the study has made it hard for the procurement ofsufficient pay loaders, bulldozers, tippers, compactors, incinerators, waste bins,refuse vans etc.; more than 69% of the respondents knew nothingabout procurement of dustbins, dumpsites and didnot also know the organs of government that areresponsible for refuse/waste management; There were some legislations for refuse/wastemanagement, either

due to lack of manpower orsome other reasons, the laws were not used or are rarely used; Burning of waste was the order of the day with theattendant hazards associated with it; Some of the waste management staff were poorlytrained and there was no plan in the future to give themfurther training or improved the already acquiredskills;Resources normally voted by Government year by year to manage solid waste is always very meager.

Ogwueleka (2009) extensively studied the Municipal solid waste characteristics and management in Nigeria. The research was carried out in nine cities namely Lagos, Maiduguri, Kano, Ibadan, Makurdi, Port-Harcourt, Onitsha, Nsukka, Abuja. These cities were chosen as urbanistic representatives of the current solid waste management in Nigeria. In the study, Ogwueleka (2009) stated that poor funding is one of the main reasons for poor collection and disposal of refuse. Lack of funds according to the said study has forced most environmental protection agencies in the country to hire vehicles and maintain few staff on a permanent basis. Waste management fees according to the study are insufficient to cover for waste management; Environmental agencies do not have adequate capacity to handle the increasing solid waste mainly due to limited budgets. Other problems according to Ogwueleka (2009) include Inappropriate siting, design, operations and maintenance of dumps and landfills which haveled toincreased transfer and disposal cost and also inadequate onsite storage facilities, lack of institutional arrangement, lack of expertise and manpower to run solid waste management programmes in Nigeria. Also, majority of environmental agency workers have little or no functional background or training in engineering and management. There is no reliable measurement of generated waste. The role of the informal sector has not been recognised by environmental agencies.It was observed that 60% percent of trucks used for waste collection were always out of service at any one time. In Onitsha for example, the few available trucks breakdown frequently due to overuse; The collection vehicles are in a state of

disrepair in most cities of Nigeria; There is inadequate service coverage in most urban areas and in rural areas there is no collection;Rural dwellers have no access to waste collection service, they dump waste at any vacant plot, public space, and river or burn it in their backyard, thereby polluting the air.

In conclusion, Nabegu (2009) stated that, the overall problem of municipal solid waste is multi-faceted; many organizations, including the United Nations (UN) and various non-governmental organizations (NGOs) advocate an integrated approach to waste management by identifying key stakeholders, identifying specific issues which comprise important "stumbling blocks", and making recommendations based on appropriate technologies, local information, and pressing human and environmental health concerns.

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 THE STUDY AREA

3.1.1 Location

Bauchi, metropolis, capital of Bauchi State and its foremost traditional emirate, is in the North Eastern geopolitical zone of Nigeria. It is located between Latitudes $10^{o}16'$ 30" - $10^{o}21'$ 0" North of the Equatorand Longitudes $9^{o}48'$ 0" and 9^{o} $52^{'}30$"Eastof the Greenwich Meridian (Fig 3.1).It is on the northern edge of the Jos plateau, at an elevation of 616m. The topography of Bauchimetropolis is relatively flat in the centre.The town lies over 609.6 metres above sea level; it occupies a total land area of 3, 604 hectares (Usman and Mohammed, 2012).

The Bauchi Urban area according to the Bauchi State Urban Development Board has a radius of about 32km and comprises of only one local government area i.e. Bauchi. Bauchi town lies on the railroad from Maiduguri to Kafanchan (where it joins the line to Port Harcourt) and has road connections to Jos, Kano, Maiduguri and Gombe (Bauchi, 2015).

3.1.2 Climate

According to the Koppen Climate Classification system, Bauchi has a tropical savannah climate, "AW" type. Two main seasons are experienced in the study area; cold dry season and hot wet season. It enjoys a rainfall total of up to 1091.4mm annually; its hottest month is

usually April (with 40.56Â°C) while the coldest months are December and January with typically 6.11Â°C and 7.22Â°C respectively. The minimum and maximum annual temperatures in the metropolis are, 18.33Â°C and 32.39Â°C respectively (Nigeria: People, Population and Settlement, 2003).

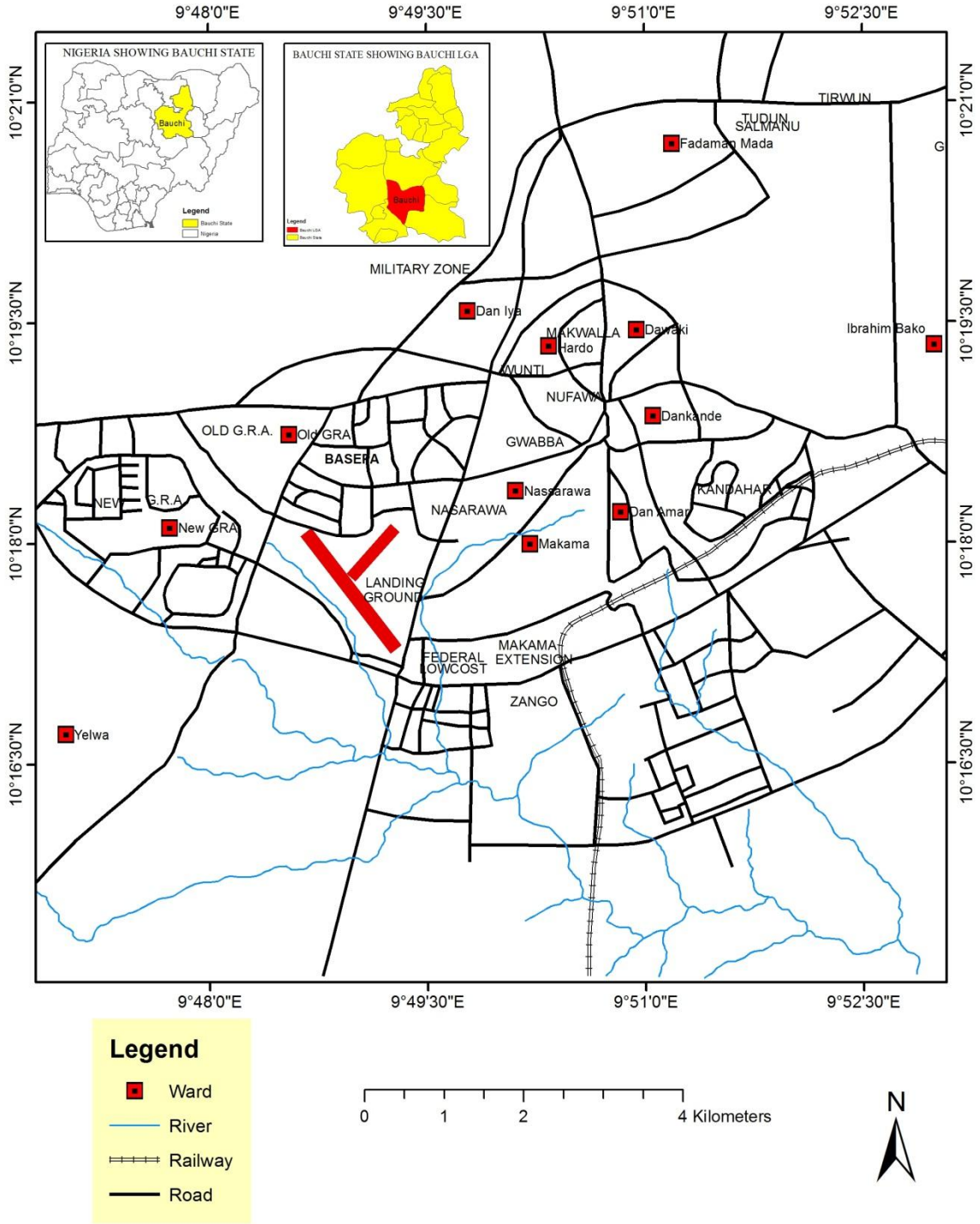


Figure 3.1: Bauchi Metropolis Showing the Wards

Source: Modified from Bauchi Street Guide Map (2003)

The sunshine hours range from about 5.1 hoursin July to about 8.9 hours in November. Indeed, October to February usually record the longest sunshine hours in the state. Humidity ranges from about twelve per cent in February to about 68 per cent in August.

The rainy season months are May to September, when humidity ranges from about 37 per cent to 68 per cent. Monthly rainfall ranges from 0.0mm in December and January, though only traces of less than 0.1 in February and November, to about 343mm in July. Onset of the rains is often in March while they end virtually in October.

Radiation is fairly even throughout the year, ranging from about 11.3mm in July to about 18.7mm in April. However, it is relatively highest in March, April, and May, when it is generally between 16.1mm and 18.7mm. Similarly, evaporation in the state ranges from 2.4mm in July and August to about 15.7mm in March, the months of January to April being the period of greatest evaporation (Nigeria: People, Population and Settlement, 2003).

Climaticfactors play a crucial role in municipal solid waste management. For example, during the wet season, heat and humidity causes the municipal solid waste to be of higher moisture content thus increasing the weight of the refuse. In addition, high humidity with heat causes the organic portion of the waste to decompose quickly leading to problems in handling and disposal, which directly affects the environmental health of the waste workers and the inhabitants (Cointreau, 1996).

3.1.3 Relief and Drainage

Bauchi state lies generally at an altitudeof about 600m above sea level, being part of the central Nigeria highlands and Jos Plateau complex. However, two broad relief zones can be identified as follows:

a. A western highland area of hill ranges, including the northern edges of the Jos Plateau complex. This is part of the crystalline rock area in central northern Nigeria. The hill ranges are developed on basement complex rocks, in area which is also characterised by extensive plateau surfaces and volcanic extrusions. The base of the hill ranges is generally at the 600m level, while peaks rise to 700.6m on the hillsand 729.3m on the Bunsil hills.

b. A central high plain (of the Hausa land) area, belonging to the Kerri Kerri and Gombe sandstone and shale, of tertiary age. Isolated hills punctuate the high plain in several places and reach heights of 798.5m on the Lamurde hill and 816.4m on the Ligri hill. Indeed, most of the isolated hills in this zone are over 760m. Bauchi town lies within the undifferentiated basement complex with older granites (out-crops) and younger granite out-crops.

Surface drainage and ground water situation

The state is drained by several river systems. The dominant one is River Gongola which originates in the Jos Plateau area, southwest of Bauchi state. It traverses, in a southwest – northeast direction through the southern local government areas of the state which includes Bauchi amongst others and thence to Gombe state. It has numerous headwater and tributaries within the state.

They include Rivers Surr, Lere, Maijuju, Rafin Bagel, Gangala and Gubi in the southwest part; Rivers Guji, Yuli, Ruhu, Dukut, and Panana in the south and southeast parts. Through these tributaries and several other small streams and rivulets, the Gongola system provides considerable advantages for the state.

The western and northern parts of the state are drained by the Rivers Bunga and Jama'are systems. The Bunga, with its many tributary, including Rivers Fanro, Magariya and Dan Warra, flows into the Jama'are system, and thence constitute part of the River Yobe system. Within the north-eastern part of the state is the River Dingaya (Dingaiye) system, with its tributaries such as River Kasi. The latter has Rivers Farin Ruwa, Jimini and many others as its own tributaries also.

In the extreme northern part of the state,is a considerable stretch of the River Katagum system. Thus, the state has considerable surface drainage systems that could be harnessed for development purposes. This is more so, in view of the fact that much of the state lies within very poor ground water provinces. For instance, within the basement complex crystalline rock areas, ground water is very unpredictable.

Only secondary aquifers occur in rock fractures, joints or weathering profiles. Water table is restricted to sub-basins in localised, isolated patches. Borehole yields are often very variable. In the sandstone areas, ground water occurs mainly within depths of 183m, while boreholes have moderate yields of about 5,000 litres per hour (Lph). Ground water from this formation is said to be generally suitable for domestic and industrial uses. On the whole, the state would more profitably rely on impounded surface river reservoirs (dams) than on boreholes for groundwater (Nigeria: People, Population and Settlement, 2003).

3.1.4 Soils

The dominant rocks are the Basement rocks which outcrop in the western part of the state. The younger granites occur as small strip within which there are scattered outcrops of the basement rocks. A broad region of Keri Keri formation occupies most of the central portion

of the state. To the far east of the state, there are many outcrops of cetaceous sedimentary formations, with occasional outcrops of both the younger granites and basement rocks. The far northern tip of the state is lacustrian silts, clays and sands of upper chad formation (Orazulike, 1992)

Those parts of the state that are underlain by expansive soils have yet to be completely delineated. However, the general distribution of soils throughout the state followsbroadly the general distribution of rock types. Hence,the most widespread soil types in the state are sandy loams on iron pan, underlain by Kerri Kerri formation. They can be deep or shallow but characteristically impoverished. These contain little or no clay minerals and do not pose any hazards due to soilexpansion. Soils on crystalline rock areas, in the western part of the state are found in basins between crystalline rock outcrops. These are typically clayey, shallow to moderately deep grading into weathered granite at depth. These are found around Bauchi town. Bauchi soil studied contain high amounts of expansive clays-montmorillonite and illite (Orazulike, 1992).

Laterite soil characterized the higher areas of the Bauchi plains, while the more productive clay and loam occur along the flood plain and provide fertile farm lands and good residential, commercial, industrial, institutional and public development areas (Usman and Mohammed, 2012)

3.1.5 Vegetation

Bauchi state is one of the states in the northern part of Nigeria that span two distinctive vegetation zones namely, the Sudan Savannah and the Sahel Savannah.

The Sudan savannah type of vegetation covers the southern part of the state of which Bauchi town falls under. Here the vegetation gets richer and richer towards the south, especially along water sources or rivers, but generally the vegetation is less uniform and grasses are shorter than what grows even farther south, that is, in the forest zone of the middle belt. The vegetation is composed mainly of *Combretaceous* trees and shrubs, *Afzelia*, *Anogeissus* and *Detarium* savannah woodlands (Abdul, Abdullahi, Sanusi and Sawa, 2009)

The Sahel type of savannah, also known as semi-desert vegetation, becomes manifest from the middle of the state as one moves from the state's south to its north. This type of vegetation comprises isolated stands of thorny shrubs (Bauchi, 2015).

The following are the common trees found in Bauchi state: Baobab (*Adansonia digitata*), Neem (*Azadirachta Indica*), Locust bean (*Parkia biglobosa*), domesticated crops include maize, millet, sorghum, rice, groundnut, cowpeas, soyabeans and vegetables such as spinach, carrots, spring onions and Okro. Water melon is also in abundance in Bauchi state.

3.1.6 Population and Economic activity

Projected from the 2006 census, using the state's inter census growth rate of 3.39%, the population of Bauchi metropolis (i.e. 493,730)as at 2014 was 644,641. The sex ratio generally across the state was 105 males to 100 females.The population of Bauchi town comprisesmany ethnic groups, the main ones being Gerawa, Sayawa, Jarawa, Bolawa,Fulani and Hausa(United Nations High Commission on Refugee Statistical Yearbook, 2006). According to Babanyara and Bogoro (2011),civil servants constitute up to 55% of the town's work force, artisans such as traders, carpenters, masons, cobblers and farmers makeup the remaining work force.This could be good for effective solid waste management because

office work compared to farming for example, is less stressful and time consuming. Hence, people are more likely have ample time to engage in solid waste management activities.

Bauchi metropolis has witnessed tremendous transformations in recent times, in terms of population growth and uneven urbanization, these were as a result of the improved relative peace and economic activities and the instability of neighbouring cities like Jos in plateau state, Damaturu and Potiskum in Yobe state, Gombe town and Maiduguri in Borno state, which result in massive influx of people relocated to the metropolis. There are indications that the population of the town would double itself. The town comprises the old town in the centre, surrounded by the town wall (Ganuwa) which is the high density area, and from outside; are the medium and low density areas surrounding the old town. However, apart from the old town most of these other areas were laid out with a proper town plan and basic infrastructure, such as paved-roads, pipe borne water and good drainage system in some areas (Usman and Mohammed, 2012).

3.2 METHODOLOGY

3.2.1 Reconnaissance Survey

A reconnaissance survey was carried outto get acquainted with thestudy area and seek the approval/cooperation of the Bauchi State Environmental Protection Agency. The reconnaissance survey was important because it enabled the researcher gain some knowledge about municipal solid waste management issues in the area and adopt a suitable and appropriate research design.

3.2.2 Types of Data

The set of data used for this research include data on the;

i) mandate of BASEPA with respect to Municipal Solid Waste Management.

ii) perception of the public with respect to the role being played by BASEPA in Municipal Solid Waste Management.

iii) role of BASEPA in Municipal Solid Waste Management

iv) constraints to Municipal Solid Waste Management in Bauchi town

3.2.3 Sources of Data

3.2.3.1 Primary sources of data

The sources of primary data used for this research are; questionnaire and unstructured oral interviews.

Questionnaire was distributed to residents of the study area in order to source data on the perception of the public and the role of BASEPA with respect to municipal solid waste management in the study area.

Unstructured oral interviews were conducted with the management of BASEPA in order to source data on the legal structure of BASEPA with respect to municipal solid waste management as well as constraints to municipal solid waste management in the study area.

3.2.3.2 Secondary sources of data

The secondary data was sourced from BASEPA, National Population Commission and NESREA, Bauchi state ministry of lands and survey, and the Bauchi State Urban Development Board.

Literature materials on the other hand were sourced from books, journals, published and unpublished texts, documents, magazines conference articles, and the internet.

3.2.4 Sample size and sampling technique

The need to employ a sampling technique that would ensure a proper representation of the population of the town here is necessary. Hence,a multi- stage sampling method was employed for this study. Multi-stage sampling technique is sampling done sequentially across two or more hierarchical levels (Battaglia, 2008).

Sampling stage 1: The study areacomprised the whole of Bauchi town. According to the Bauchi State Urban Development Board, Bauchi town/Urban area has a radius of about 32km.

Sampling stage 2: In this stage, the study area (Bauchi town) was broken down into wards. Bauchi town comprises of 12 wards namely Old GRA, New GRA, Fadaman Mada, Yelwa, Dan Iya, Makama, Ibrahim Bako,Nassarawa, Dan Kade, Dawaki,Dan Amar and Hardo. All the twelve wards were selected for the study.

According to the Bauchi State Environmental Protection Agency in Babanyara and Bogoro (2010), there are a total of 39,675 households in Bauchi out of which Old GRA has 2192 households; New GRA, 1197; Fadaman Mada, 2885; Yelwa, 6563; Dan Iya, 3810, Makama, 1517; Ibrahim Bako, 2250; Nassarawa, 4170; Dan Kade, 3737; Dawaki, 4790; Dan Amar, 4816; Hardo, 1748.

Sampling stage 3: To determine the sample size, Slovin's formula was used (Yamene, 1976):

$$\frac{N}{1 + N(0.05)^2}$$

(Slovin's Formula)

Where N = Total population of households in the study area (39,675)

0.05 = Acceptable error size

Therefore, based on the formula above, 396 respondents were sampled in the study area.

Sampling stage 4: To determine the number of respondents in each ward, Bowley's (1962) proportional allocation technique wasused, it is given as;

$$\frac{nh = ni}{N}$$

N = Total Household Population (39,675)

n = Total Sample Size (396)

h = Total Household Population of each ward

ni = Sample size for each ward

Thus, a total number of 396 households were sampled in the study area with each ward getting a proportionate amount. The questionnaire wasrandomly distributed in order for each member of the population under study to have equal chance of being selected i.e. to reduce bias. The breakdown of each ward's household population and sample size is given in table 3.1;

Table 3.1 Household population and sample size

WARDS	HOUSEHOLD POPULATION	SAMPLE SIZE
Old G.R.A	2192	22
New G.R.A	1197	12
Fadaman Mada	2885	29
Yelwa	6563	66
Dan Iya	3810	39
Makama	1517	15
Ibrahim Bako	2250	23
Nassarawa	4170	42
Dan Kade	3737	37
Dawaki	4790	45
Dan Amar	4816	48
Hardo	1748	18
Total	**39,675**	**396**

Source: Author's Compilation, 2015

3.2.5 Data Analysis

Due to varied data generated from the survey, descriptive statistics was employed in analysing data. The breakdown of how the objectives were achieved is given as follows;

i. *To identify the extent to which the Bauchi State Environmental Protection Agency has achieved its mandate with respect Municipal Solid Waste Management in Bauchi*

metropolis: the data used to achieve this objective were gotten from observation/field survey, interview and questionnaire administration. The results were presented using tables, pie charts and bar charts.

ii. *To examine the perception of the public on the role of the Bauchi State Environmental Protection Agency in Municipal Solid Waste Management in Bauchi metropolis:*To achieve this objective, Kruskal Wallis test was used. Numerical values were assigned to the relevant questionnaire items using 5 point likert scaleand the test was run using SPSS 2.0.

The Kruskal- Wallis test statistic is approximately a Chi- Square distribution, with K-1 degrees of freedom where the number of participants per group should be greater than 5. If calculated value of the Kruskal-Wallis test is less than the critical Chi-Square value, it is assumed that there is a significant difference in perception amongst the public with respect to the role of BASEPA in MSWM. However, if the calculated value of Kruskal-Wallis test is greater than the critical Chi Square value, then it is assumed that there is no significant difference in perception amongst the public with respect to the role of BASEPA in MSWM

Note that the Kruskal-Wallis test merely tells you that the groups differin some way you need to inspect the group means or medians to decide precisely how they differ.

iii. *Identify public domain ways of increasing the effectiveness of the Bauchi State Environmental Protection Agency:* the data used to achieve this objective were gotten interview and questionnaire administration. The results were presented using tables, pie charts and bar charts.

iv. *Identify the constraints militating against effective Municipal Solid Waste Management in Bauchi metropolis:* the data used to achieve this objective were obtained from observation, questionnaire and interview. The results were presented in a table.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter,results obtained from the field research, are presented and discussed in order to achieve the research objectives which are; to examine the mandate of BASEPA with respect to MSWM in Bauchi metropolis, to identify the extent to which BASEPA has achieved its mandate with respect to MSWM, to examine the perception of the public with respect to the role of BASEPA in MSWM in Bauchi metropolis and to identify the constraints militating against effective Municipal Solid Waste Management in Bauchi metropolis

A total of 396 copies of the questionnaire were distributed but only 318 copies were returned. Thus, a total of 318 copies of the questionnaire were used for the analysis.

4.2 DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

This section discusses the demographic and socio-economic characteristics of respondents which include sex, age, educational level and occupation type, marital status, household number and monthly earnings of respondents.

4.2.1 Sex of respondents

The sex structure as shown in Figure 4.1, indicates that majority of the respondents were males constituting 70.8% while the females, constitute 29.2%.

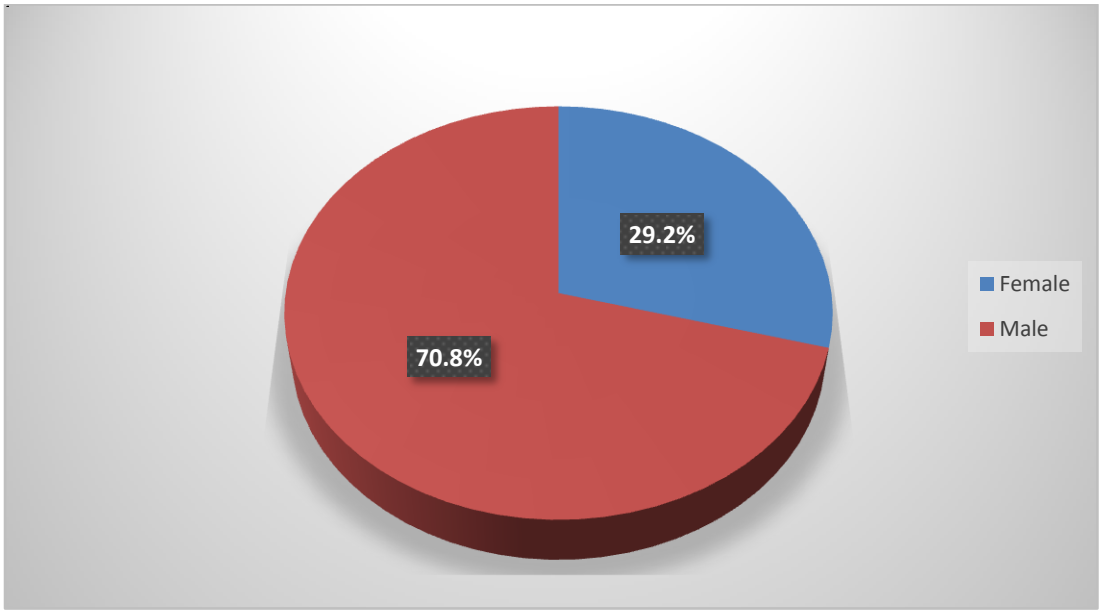


Figure 4.1: Sex distribution of respondents

Source: Field Survey, 2015

The reason for the disparity in sex distribution is because of culture and the target population of the research i.e.the study area is a core Northern city where most women are at home as full-time house wives and the heads of households (the target of this research) are usually men. But as observed during the field survey, most of the solid waste management activities carried out in the household are done by women. Activities such as collection and disposal of solid wastes forms part of the everyday chores of women in Bauchi metropolis.

Chuwang (1997) reported that sex and age are the main determining factors in household refuse handling, particularly carrying the filled storage facilities to collection centres. The author further asserted that the division of householdlabour is biased towards women and

waste disposal is one of such household duties. Women and girls gather, store and evacuate the refuse in the household, a responsibility which is attributed to African culture irrespective of income level.

4.2.2 Age, Educational level and Occupation of respondents

Table 4.1 shows the age educational level and occupations of respondents. The age-structure is important in study because often, people of differing ages view issues differently. The overall age profile of respondents depicted in Table 4.1 shows that 39% of respondents belonged to the 28-37 year age category and the lowest proportion of (1.6%) appeared in the 58-67 year age group.

Table 4.1 Age, Educational level and Occupation of respondents

Age(Years)	**Frequency**	**Percentage (%)**
18-27	92	28.9
28-37	124	39.0
38-47	63	19.8
48-57	19	6.0
58-67	15	4.7
>68	5	1.6
Total	**318**	**100**
Educational level		
Primary	4	1.3
Secondary	34	10.7
Tertiary	266	83.6
Others	7	2.2
No response	7	2.2
Total	**318**	**100**
Occupation type		
Farming	8	2.5
Trading/business	25	7.9
Civil service	177	55.7
Artisan	8	2.5
No response	100	31.4

Total	**318**	**100**

Source: Field Survey, 2015

The result suggests that most of the respondents are youths. Active and with less responsibilities, youths can contribute greatly towards solid waste management especially in areas like waste evacuation which can be physically intensive and time consuming.

The distribution of respondents by educational attainment as shown in Table 4.1 reveals that majority of the respondents are literate (a total of 97.8%) which cuts across different educational backgrounds. Literacy according to Babanyara and Bogoro (2011) facilitates the use of modern communication channels which are necessary for effective Municipal Solid Waste Management thus a good prospect for effective Municipal waste management in Bauchi metropolis if utilised well.

Table 4.1 also shows the occupations of respondents. The results show that most of respondents (55.7%)are civil servants, 2.5% of the respondents are Artisans (engage in jobs such as carpentry, welding, baking) and 31.4% of the respondents didn't indicate their occupation, this is due to the fact that the researcher was a stranger to most of the respondents. A lot of people are wary of giving out details about themselves because of security issues. The finding here is similar to what Babanyara and Bogoro (2011) obtained in a study on solid waste evacuation in Bauchi metropolis. In the said study, the authors discovered that 55% of the respondents were civil servants thus, stating that the high percentage of civil servants amongst the respondents, lends credence to the well-known fact that Bauchi town is not a commercial or industrial town. This could be good for effective solid waste management because office work compared to farming for example, is less stressful and time consuming. Hence, people will have ample time to engage in solid waste management activities.

4.2.3 Marital status, Household number and Monthly earnings of respondents

Table 4.2 shows the marital status, Household number and Monthly earnings of respondents. As indicated in Table 4.2, 59.4% of the respondents were married and the reason for the high percentage of married respondents, is the prevalent culture in the study area which encourages early marriage and frowns at the single way of living and also, the target of this study were the households.

Table 4.2: Marital status, Household number and Monthly earnings of respondents

Marital Status	**Frequency**	**Percentage (%)**
Married	189	59.4
Single	115	36.1
Widowed	6	1.9
Divorced	8	2.6
		100
Total	**318**	
Household size		
1 -10	207	65.2
11 -20	78	24.5
21 – 30	11	3.4
30 and above	2	0.6
No Response	20	6.3
Total	**318**	**100**
Monthly earnings		
< ₦18,000	81	25.5
₦19,000 - ₦50,000	77	24.2
₦51,000 - ₦82, 000	74	14.8
₦83,000 - ₦114,000	38	11.9
₦115000 and above	62	19.5
No Response	13	4.1
Total	**318**	**100**

Source: Field Survey, 2015

From Table 4.2 the result for the household size of respondents indicates that, most of the respondents (65.2%) live in extended family units. The large household size is a typical characteristic of polygamous family structure which is common in the study area. As indicated by Babanyara and Bogoro (2011), in terms of solid waste management, large household size generates more wastes, but can also be an advantage where the family members carry the solid waste storage containers to the collection centres themselves. In the same vein, large household sizes can provide free and cheap labour for solid wastes evacuation to collection centres and it also encourages community effort toward evacuation of refuse from collection centres to disposal sites.

Table 4.2 also shows the monthly earning of respondents. The result indicates that, most of the respondents earn 18,000 or less which for some is less than or equal to the minimum wage in Nigeria.This could negatively affect solid waste management because, with low income, respondents are less likely to be willing to pay for such activities and paying in most instances is the only way towards effective Municipal Solid Waste Management. Findings in a study by Nshimirimana (2004) suggests that the level of household income is indeed correlated with life style of the household. Poverty, according to the said study, contributes to domestic solid waste mismanagement.

4.3 THE EXTENT TO WHICH BASEPA HAS ACHIEVED ITS MANDATE ON MUNICIPAL SOLID WASTE MANAGEMENT

This section discusses the existing practices and management of municipal solid waste in Bauchi metropolis.

4.3.1 Name of Government Institution responsible for MSWM in Bauchi metropolis

Figure 4.2 shows the distribution of responses on the Government institution responsible for MSWM in Bauchi metropolis.

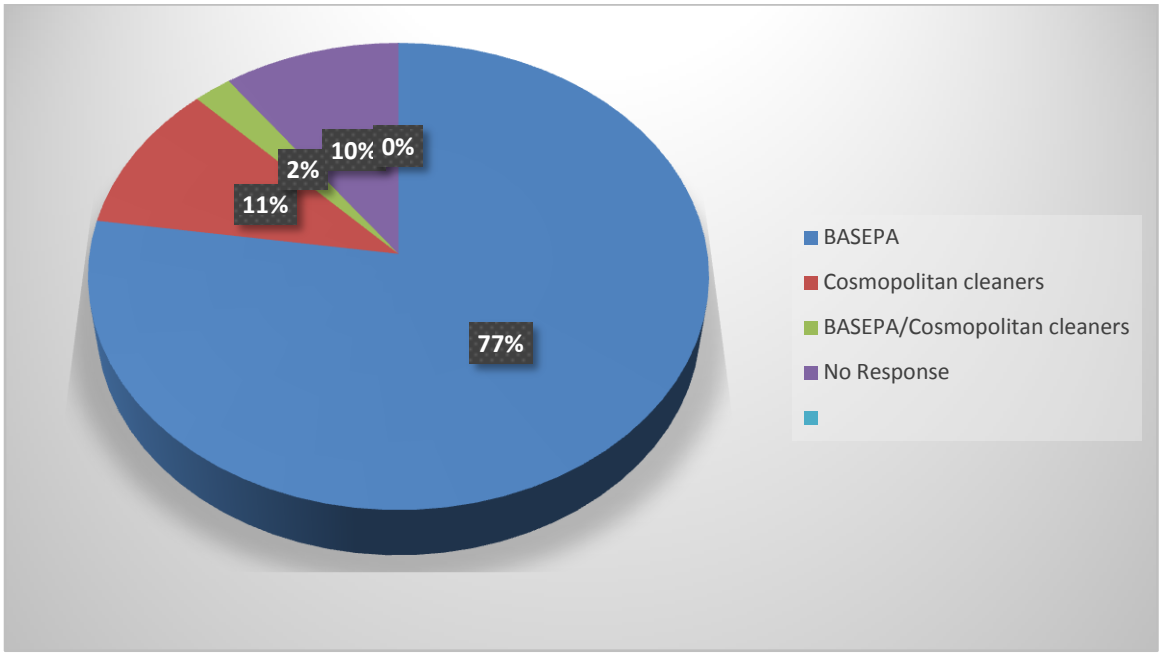


Figure 4.2: Name of Government Institution responsible for MSWM in Bauchi metropolis

Source: Field survey, 2015

Figure 4.2 indicates that 77.4% of the respondents answered the question correctly by stating BASEPA, 10.4% wrote Cosmopolitan Cleaners which is the popular private waste handling company in the study area while 2.2% wrote both BASEPA and Cosmopolitan Cleaners. 10% however did not give any response indicating that they either don't know the name of the institution responsible for MSWM or they don't know such an institution exists. Overall, the result indicates that the majority of the respondents know there is an agency responsible for municipal solid waste management in the study area.

Section 5 of the Bauchi state Environmental protection and Conservation Agency edict No. 3 of 1997 (i.e. the edict establishing BASEPA and still in use) states that "there is hereby established an Agency for the whole state to be known and called as the Bauchi State Environmental Protection Agency thereinafter referred to as the Agency (BASEPA)".Section 6 of the said edict states that the Agency shall be a legal entity with perpetual succession and a common seal with a power to sue and be sued and section 9(7), states that BASEPA has the sole responsibilities on all matters relating to environmental protection, sanitation and environmental research and policy.

4.3.2 Methods of solid waste disposal in Bauchi metropolis

Figure 4.3 shows the methods of solid waste disposal in Bauchi metropolis. Figure 4.2 shows the result of responses on how solid wastes are disposed in Bauchi metropolis. About 66.4% of the respondents dispose solid wastes in waste bins while 2.8% dump waste by the road side and in open dumps near houses.

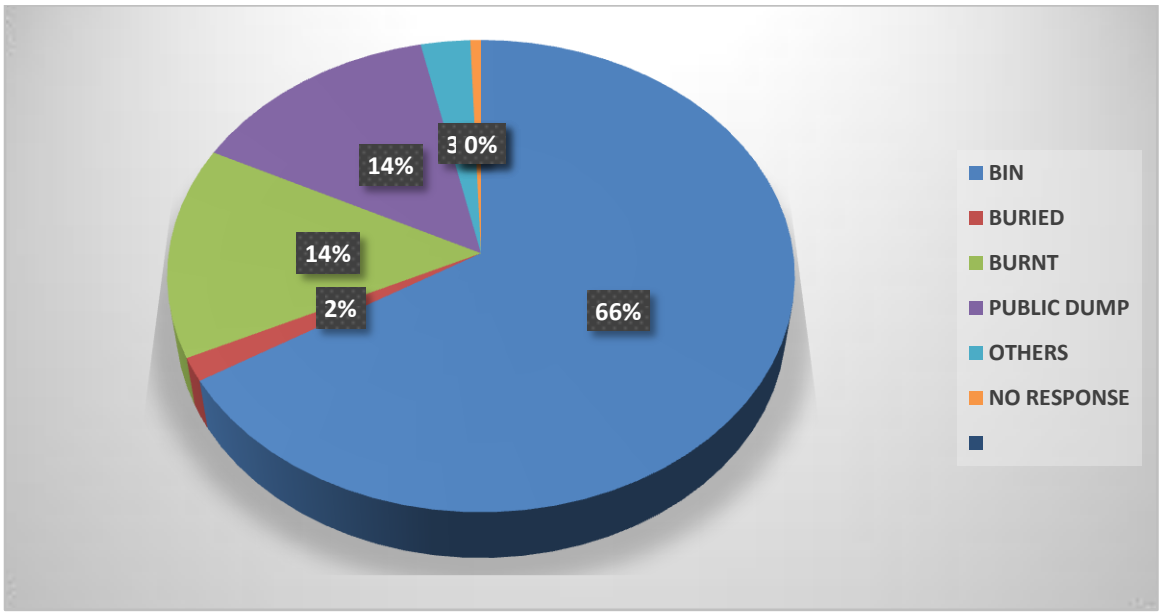


Figure 4.3 Methods of solid waste disposal in Bauchi Metropolis

Source: Field survey, 2015

The result indicates that most of the respondents dispose solid wastes in waste bins which are situated within the houses. This is the manner in which the law states that waste should be disposed. Sections 27 and 28 of the BASEPA edict states clearly that every owner or occupier of a tenement shall provide a dustbin outside the tenement to be used for disposing waste and no person shall burn or cause to be burnt or any tenement waste of any description.

According to Babanyara and Bogoro (2011), the need for individual on-site solid waste storage facilities in every household is important because, the waste dispose in open dumps and road side and open spaces in general are usually the ones that overflow and litter the place constituting nuisance to the public and jeopardising evacuation efforts. For instance, there were many reported cases of fire outbreaks caused by refuse burning within or near residential buildings.Also, according to Nshimirimana (2004), when household waste disposal practices are known, it would be easier to introduce measures to reduce the amount of waste generated by the affected community

4.3.3Distribution of solid waste dumps, location and effects

Table 4.3 shows the distribution of solid waste dumps, their location and effects.Majority of respondents (71.7%) indicated that they have waste dumps in their area.Field observations in the course of this research reveals the study area is dotted with dump sites, a lot of which are illegal.

Also, Ogwuche (2013) alluded to this fact stating that open dumping of solid waste is a common practice in Bauchi metropolis, as there are virtually few designated sites approved by BASEPA for dumping of solid waste. According to the author, the practice is also indiscriminately carried out at various locations in the municipality.

Table 4.3 also shows responses on the locations of solid waste dumps in the study area. Out of the 228 respondents that said they have dumps/dumpsites in their areas, most (48.7%) stated that they are situated by the roadside/walkways while 10.1% selected the other option given varying answers such as on farmlands, abandon wells etc. The result indicates that the practice of indiscriminate dumping of waste is rife in the study area and most illegal dumps/dumpsites were situated by the roadside.

Table 4.3: Distribution of solid waste dumps, location and effects

Presence of solid waste dumps	**Frequency**	**Percentage**
Yes	228	71.7
No	87	27.4
No response	3	0.9
Total	**318**	**100**
Location of solid waste dumps		
By the roadside	111	48.7
Far from buildings	36	15.8
Near buildings	53	23.2
Inside drainages	1	0.4
Others	23	10.1
No Response	4	1.8
Total	**228**	**100**
Effects of indiscriminate dumping		
Smells badly	21	9.2
Obstructs traffic	8	3.5
Blocks drainages.	28	12.3
Harbors insects	20	8.8
More than one option	148	64.9
Others	3	1.3
Total	**228**	**100**

Source: Field survey, 2015

This can be attributed to a government policy introduced around 2012. The policy encourages households and businesses to dump their solid wastes by the road side for collection/evacuation by BASEPA or any of its private affiliated private waste companies but because the collection/evacuation is not carried out as at when due, the waste have turned roadsides especially into illegal dumpsites. Examples can be seen in Plates II, III and IV.



PLATE II: Illegal Waste Dump by the Road side along Titin Nasarawa, Bauchi
Source: Field Work, 2015



Plate III: An overflowed dump in Sabon Gari area
Source: Field work, 2015



Plate IV: A Dumpsite close to Residential buildings in Bakin Kura Area
Source: Field work, 2015

Table 4.3 shows responses on effects of dumps/dumpsites. The responses show that out of the 228 respondents that said they have illegal dumps in their area, most (i.e. 64.9%)selected more than one option.The result reveals that the negative effects of open dumps are multiple in the study area i.e. they smell badly, obstruct traffic, block drainages, Harbor insects/pests and in addition, they make the environment filthy, unattractive and some especially those situated in uncompleted buildings serve as hideouts for criminals and mentally challenged individuals.

A study by Ogwuche (2013), made similar findings stating that open dumps serve as habitation for rats, snakes and other dangerous reptiles and animals in addition to the emission of offensive odour. According to Nshimirimana (2004) and Poswa (2000), rats and other vermin are attracted to food waste found in dumped residential or business trash and illegal dumping demotivates residents, reducing their sense of ownership andcontrol over their surroundings

because, illegal dumping sites can become magnets for crime and forms of urbanblight, such as abandoned automobiles and graffiti.

4.3.4 Responsibility for solid waste evacuation and payment in Bauchi metropolis

Table 4.4 shows the distribution of responses on responsibility for solid waste evacuation and payment in Bauchi metropolis

Table 4.4 Responsibility for solid waste evacuation and payment in Bauchi metropolis

Responsibility for solid waste evacuation	**Frequency**	**Percentage**
BASEPA	178	56.0
Private company	85	26.7
Community	27	8.5
Others	25	7.9
No response	3	0.9
Total	**318**	**100**
Payment for solid waste evacuation		
Yes	123	38.7
No	192	60.4
No response	3	0.9
Total	**318**	**100.0**

Source: Field survey, 2015

Table 4.4 shows responses on who evacuates waste in Bauchi metropolis. The result reveals that most of the solid waste evacuation work in the study area was undertaken by BASEPA. This of course is one of BASEPA's functions as enshrined in the edict section 9(5). Section 10(1) of the BASEPA edict grants the agency the power to enter into contract with any per-

son for the purpose of executing its responsibilities and functions. Although BASEPA engages the services of private waste disposal companies and community organisations as indicated by respondents and as revealed during interview with the management of BASEPA, from the findings of this study, the level and scale of cooperation is low and needs to be raised if effective municipal solid waste management is to be achieved in Bauchi metropolis bearing in mind the high amount of waste and the limited operational capability of BASEPA.

Table 4.4 also shows responses on whether respondents pay for their waste to be evacuated. The result reveals that most of the respondents (60.4%) do not pay to have their waste evacuated. This is due to the fact that BASEPA does not charge for waste evacuation services and private waste handling companies (who usually charge for evacuation services) operate only in limited places in the metropolis, mostly high income areas such as the G.RA.

4.3.5Responses on sorting/separation/segregation of solid waste before disposal

Figure 4.4 shows the distribution of responses on sorting/separation of solid waste before disposal in Bauchi metropolis.The result reveals that most of respondents (61.3%) do not sort/separate/segregation their solid waste before disposal. This is due to lack of awareness on the benefits/advantages of sorting as a means of solid waste management, how to go about sorting/separation/segregation in general and the lack of schemes and modern facilities for waste sorting/separation/segregation in the study area.

Gani, Chiroma and Gana (2012) made a similar finding that, the level of solid waste segregation in Bauchi metropolis is poor, especially in the high density area of the walled-city. One of the reasons given by the study for the poor level of segregation in Bauchi metropolis, is the

ownership of only one waste bin each by about 90% of the respondents. Though a valid reason, this cannot be the main reason because segregation can be done in different other ways.

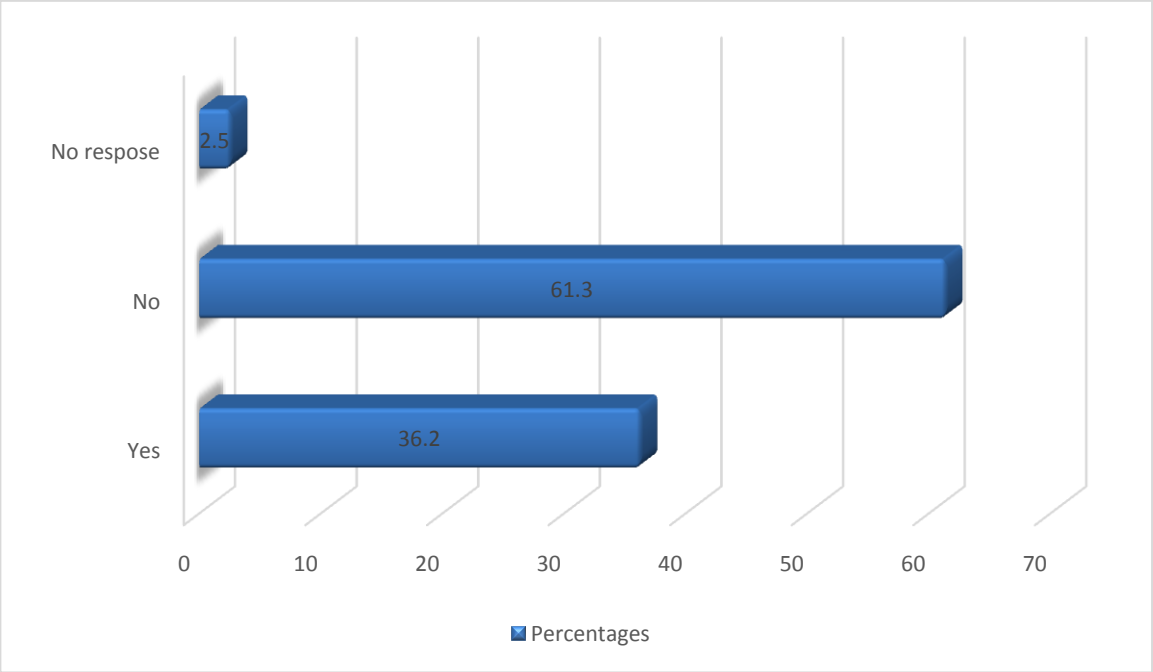


Figure 4.4: Responses on sorting/separation/segregationof solid waste before disposal

Source: Field survey, 2015

As stated by Nshimirimana (2004), segregation can be done manually at the household and collected through curbside collection schemes, or automatically in materials recovery facilities or mechanical biological treatment system. According to Fuggle and Rabbie (1992), sorting/separation of waste has the following advantages: recovery of usable material/ prevent the disposal of recyclable materials, reduce the amount of solid waste sent to landfills and reduce budget allocation for solid waste disposal thereby reducing cost.

4.3.6 The role of sanitary inspectors in solid waste management in Bauchi metropolis

Table 4.5 shows the distribution ofresponses on the role of sanitary inspectors in solid waste management in Bauchi metropolis.Table 4.6 shows responses on the availability of sanitary

inspectors in the study area. The result as revealed by 47.8% of respondents indicates that most areas in Bauchi metropolis were not assigned sanitary inspectors. Also, 33.9% of the respondents were not sure whether they have sanitary inspectors or not obviously because they have never seen any inspectors.As one of the powers of the Agency, section 10(10) states that "conduct inspection and a programme of continued surveillance to ascertain possible violation of this edict or the regulations made hereinafter". The lack of inspectors in many parts of the study area as indicated by respondents shows the agency is not exercising one of its powers as enshrined in the edict.

Table 4.5 reveals that sanitary inspectors mostly visit on a monthly basis (44.4%). The implication of this is the high level of solid wastes littered all over the metropolis at most times. If inspections were carried out at more regular intervals, residents and whosoever is responsible for solid waste evacuation will ensure prompt evacuation of the wastes so as not to be found wanting by the authorities.

Table 4.5 also shows responses on how sanitary defaulters are dealt with. The result indicates 24.1% of solid waste management defaulters are usually charged to court. This is in line with section 14 of the edict which stated thus "there is hereby established for the purpose of this edict a mobile court to be known and call as the environmental protection court which shall be presided over by a legal practitioner of not less than five years post call experience to be appointed by the chief judge of Bauchi state on the recommendation of the Attorney General of Bauchi State". The researcher witnessed a court session in which a resident was charged with dumping of waste in his neighbour's backyard, the judge ruled that the culprit should

evacuate the waste and pay a fine of two thousand naira. The court session is usually held every Thursday at the premises of BASEPA.

Table 4.5: Role of sanitary inspectors in solid waste management in Bauchi metropolis

Availability of sanitary inspectors	**Frequency**	**Percentage**
Yes	54	17
No	152	47.8
I don't know	108	33.9
Others	1	0.4
No Response	3	0.9
Total	**318**	**100**
Sanitary inspection routine		
Daily	6	11.1
Weekly	16	29.6
Monthly	24	44.4
Others	8	14.9
Total	**54**	**100**
Punishment for sanitation defaulters		
Fine them	10	18.5
Charge them to court	13	24.1
Caution them	11	20.3
Force them to conform	10	18.5
Others	5	9.3
No Response	5	9.3
Total	**54**	**100**

Source:Field survey, 2015

Also, section 10(11) and(16) empowers the agency to "stop or cause to be stopped any act or omission that is in violation of any principle of decent environment" and "to do anything possible that is necessary and/or incidental to carrying out functions or activities as provided by

this edict" respectively. Thus as shown, the agency has unlimited powers to see to the effective management of waste in the study area.

4.3.7 Responses on ancillary services provided by BASEPA

Table 4.6 shows the distribution of responses on ancillary services provided by BASEPA. Table 4.6shows responses on whether BASEPA provides services such as street sweeping and drainage clearance. The result reveals that although most of the responses were in the affirmative, a high percentage of the respondents (40.8%) in the study area, do not have such vital services.

In the law establishing the Kano State Refuse Management Board (REMASAB) i.e. law No 7, section 4(1), the functions of the agency were clearly specified and prominent amongst the functions are street sweeping and drainage clearance but as important as these services are to the effective management of solid waste, it is pertinent to note that no part of the edict Establishing BASEPA clearly and specifically mentions it. This is one of the shortcomings of the edict No.3 of 1997.

From table 4.6 also, out of the 183 respondents that said BASEPA provides services such as street sweeping and drainage clearing,50.8% said such services were carried out on daily basis. Also, 10.9% of the respondents said such services are only carried out once in a while mostly during special occasions. Carrying out such vital services not regularly, contributes to accumulation of solid wastes and these accumulated solid wastes are spread all over by elements of weather such as rain and wind thereby littering the place.

Table 4.6 also indicates 30.8% of respondents said BASEPA provides other services like separation/sorting, recycling, composting. When asked which and how BASEPA provides such services, neither of the 30.8% of the respondents that say they do, could provide an answer.

Table 4.6:Distribution of responses on ancillary services provided by BASEPA

Provision of street sweeping and drainage clearing services by BASEPA	**Frequency**	**Percentage**
Yes	183	57.6
No	130	40.8
No Response	5	1.6
Total	**318**	**100**
Street sweeping and drainage clearing routine of BASEPA		
Daily	93	50.8
Weekly	39	21.4
Monthly	31	16.9
Others	20	10.9
Total	**183**	**100**
Provision of services such as recycling, sorting, composting by BASEPA		
Yes	98	30.8
No	209	65.7
No Response	11	3.5
Total	**318**	**100**

Source: Field survey, 2015

At the time this research was conducted from observations and interviews conducted, BASEPAundertakes only waste evacuation as a technique for waste management in the study

area. This is further corroboratedby the Spokesperson Agency that activities like sorting, composting and pyrolysis, were part of its future plans.

Section 9(2) of the edict states that "the agency shall implement environmental policies towards protection, sustenance and development of the environment generally". Although not explicitly stated in the edict, recycling, sorting, composting and the like are solid waste management techniques that can be categorised as policies that can protect, sustain and develop the environment generally. Almost two decades after establishing the agency and such important policies are yet to be implemented, shows negligence and clear dereliction (by BASEPA) from its duties as enshrined in the edict.

4.3.8 Residents opinion on Municipal Solid Waste Management Services by BASEPA

Table 4.7 shows the distribution of residents' opinion on Municipal solid waste management activities by BASEPA. The Table reveals that 57.9% of respondents are not satisfied with the solid waste management services of BASEPA in general. The result indicates that the waste management services in the study area is not satisfactory. This result is supported by Babanyara and Bogoro (2011) which indicated that, it is certain that generation of solid waste in Bauchi metropolis is on the increase but the evacuation exercise has been ineffective. The said study stated that, every day on the average, BASEPA evacuates 68.70% (192.5m3) of 280.20m3 of the solid waste generated daily in the metropolis. The remaining, 31.30% is not collected, as such solid wastes continueto accumulate and this is evidenced by the heaps of solid wastes scattered all over Bauchi metropolis.

Table 4.7 also shows how respondents answered the question on why they are not satisfied with the waste management services in their area. So, of the184 respondents who indicated

that they weren't satisfied with the waste management services of BASEPA, 33.7% selected more than one option indicating that the reasons for dissatisfaction with the solid waste management services of BASEPA are multiple in most cases i.e. a combination of two or more of: unreliability of service, low frequency of service, lack of clean appearance around the waste bin area after evacuation and high cost of evacuation services.

Table 4.7: Distribution of residents' opinion on MSWM by BASEPA

Satisfaction with SWM services of BASEPA	**Frequency**	**Percentage (%)**
Yes	131	41.1
No	184	57.9
No Response	3	0.9
Total	**318**	**100**
Reason(s) for not being satisfied with BASEPA's SWM services		
Unreliability of service	34	18.5
Low frequency of service	42	22.8
Lack of clean appearance around the - waste bin/area after evacuation	27	14.7
High cost of evacuation services	8	4.3
Others	11	6
More than one option	62	33.7
Total	**184**	**100**
Responsibility for poor solid waste management		
Residents of the town	82	25.8
BASEPA	186	58.5
Private Waste Handling Companies	10	3.1
Others	34	10.7
No Response	6	1.9
Total	**318**	**100**

Source: Field survey, 2015

.

Also, responses on responsibility for solid waste mismanagement shows that 58.5% opined that BASEPA is responsible for the problem of waste mismanagement in the study area because according to the respondents, it is the constitutionally assigned body to oversee the management of solid waste as such,they are to be blamed for any failure/shortcoming in that aspect.

The assertion above when viewed critically is somehow misleading because, besides waste management being capital intensive i.e. requiring appropriate and up graded modern material and infrastructure which cost a lot and thus difficult in most cases for waste management agencies in like BASEPA with their meagre budget to acquire, solid waste management is a collective responsibility of both the authorities and the people. No matter what the authorities do, if the people concern do not get involved and cooperate, effective Municipal Waste Management will not be achieved.

Chukwuemeka, Ugwu and Igwegbe (2012) and Ogwueleka (2009) have all shown that, resources normally voted by Government year by year to manage solid is very meagre as such, insufficient to cover for waste management. Thus environmental agencies do not have adequate capacity to handle the increasing solid waste. One of the solutions proffered by the authors, is the participation of local communities in solid waste management activities.

In summary, the results obtained indicated that 71.7% of the respondents have illegal waste dumps and most are situated by the road side/walk ways. The dumps obstruct traffic, smell badly, and block drainages amongst other negative consequences as indicated by 64.9% of the respondents.61.3% of respondents do not separate their waste before disposal, only 17% indicated they have sanitary inspectors in their area and sanitary inspections are only carried out once in a month. 40.8% do not have services like street sweeping and drainage clearance,

BASEPA does not offer recycling services as indicated by 65.7% of the respondents and the agency itself. Overall, 57.9% are not satisfied with BASEPA's MSWM services and 58.5% blame BASEPA for improper SWM thus showing BASEPA's ineffectiveness in managing MSW.

4.4PERCEPTION OF THE PUBLIC ON THE ROLE OF BASEPA IN MSWM IN BAUCHI METROPOLIS

4.4.1 Kruskal-Wallis Test for the Perception of the Public with respect to the role of BASEPA in Municipal Solid Waste Management in Bauchi metropolis

Table 4.8 shows the summary of the Kruskal-Wallis test for the perception of the public with respect to the role of BASEPA in municipal solid waste management in Bauchi town.Chi-square value (H) = 67.94, significance value (p) is less than 0.001 which is less than 0.5 (i.e. critical value of Chi-Square for the degree of freedom which in this case is 4. The interpretation of the result obtainedis as follows;

The Kruskal-Wallis H test revealed that there is a statistically significant difference in perception amongst the public with respect to the role of BASEPA in Municipal Solid Waste Management in Bauchi metropolis.

From the result it can be deduced that BASEPA's MSWM role in terms of addressing environmental issues in Bauchi town with a mean score of 854.54 is perceived best by the respondents. BASEPA thus has to improve on its administrative and organisational arrangement in terms of its efficiency and effectiveness in the Management of Municipal Solid waste because it got the least mean score of 606.80.Note that a higher score in this study equates to a better level of perception.

Table 4.8 Summary of the Kruskal-Wallis Test for the Perception of the Public on the role of BASEPA in Municipal Solid Waste Management

FACTORS	FREQUENCY	MEAN RANK
Administrative and organisational arrangement.	318	606.80
Solid waste evacuation/collection and transfer/transportation services.	318	823.80
Waste prevention and control such as; minimization, recycling, energy/resource recovery and safe disposal facilities,	318	844.30
Addressing health and safety issues in Bauchi metropolis.	318	848.06
Addressing environmental issues in Bauchi metropolis	318	854.54
Provision of income and employment opportunities	318	801.41
	Degrees of freedom = 4	
	Significance value (p) < 0.001	
	Chi-square value of (H) = 67.94	

Source: Field Work, 2015

4.5 IDENTIFY PUBLIC DOMAIN WAYS OF INCREASING THE EFFECTIVENESS OF THE BAUCHI STATE ENVIRONMENTAL PROTECTION AGENCY

4.5.1 Resident's attitude towards poor solid waste management in Bauchi metropolis

Table 4.9 shows the distribution of responses on residents' attitude towards solid waste mismanagement in Bauchi metropolis.Table 4.9 shows how respondents feel when they see solid waste being mismanaged. Majority of respondents (94.3%)indicated that they feel concerned. This is not unconnected to the widely known serious consequences of waste mismanagement, which impacts negatively either on people's immediate home environment, or on the wider environment and ecology, or on both. No one wants to be affected by the negative consequences of improper solid waste disposal.

Table 4.9 Residents attitude towards poor solid waste management in Bauchi metropolis

Concern over poor waste disposal attitude	**Frequency**	**Percentage (%)**
Concerned	300	94.3
Not concerned	11	3.5
No Response	7	2.2
Total	**318**	**100**
Reaction to poor solid waste disposal attitude?		
Report him/her	20	6.3
Advise him/her against it	261	82.1
Do nothing	19	5.9
It is not a problem for me	5	1.6
Others	13	4.1
Total	**318**	**100**

Source:Field survey, 2015

The result obtained here is similar to what Nshimirimana (2004) obtained stating that the majority of respondents know that if the environment is not clean it brings down the standard of living, creates poorhygiene, and is unhealthy. The unclean environment reflects badly on the peoplewho live in that area; it also creates a bad impression of the town and affects socio-economic conditions. The study added that majority of the respondents agreed that it is important to keep theirenvironment clean to avoid pollution.

In table 4.9, majority of the respondents (82.1%) said they will advise the defaulter against what he/she is doing while 4.1% selected the other option without stating what they will do. Though passive, this attitude is good as it will not lead to aggression and if carried out well, will help in reducing improper solid waste disposal. In a study by Nshirimana (2004), 43.9% of the respondents (which constitute the highest percentage of response in that category) said they will call the cleansing department and report any person they see mismanaging waste. Although only about 6% in this research selected the option of reporting to the authorities concern, the option is also a very good one because the defaulter if reported will be dealt with appropriately by the law and this will serve as a deterrent to other defaulters and potential defaulters.

4.5.2 Community initiatives on solid waste management and participation

Table 4.10 shows the distribution of responses oncommunity initiatives on solid waste management and participation.The result reveals that 46.5% of respondents do not have any kind of community initiative to manage solid wastes and 27.4% don’t have any idea about community initiatives for solid waste management. Solid waste management activites in the study area as observed are usually done individually by households and because of this, solid waste management is not carried out consistently and effectively across the metropolis.

The findings here are similar to what Babanyara and Bogoro obtained in 2011. In the said study on waste evacuation in Bauchi metropolis, the authors stated that the level of community participation in the evacuation of solid waste in was found to be low, until recently when BASEPA partially involved communityheads who are now charged with the responsibility of monitoring the collection centres intheir jurisdiction and report to the agency when they are due for evacuation.

Table 4.10: Community initiatives on solid waste management and participation

Community initiative on solid waste management	**Frequency**	**Percentage**
Yes	76	23.9
No	148	46.5
I don't know	87	27.4
Others	1	0.3
No response	6	1.9
Total	**318**	**100**
Participation in community initiatives for solid waste Management		
	57	75
Yes	19	25
No		
Total	**76**	**100**

Source: Field survey, 2015

Table 4.10 also shows that out of the 76 respondents who opined that they had a kind of community initiative to manage solid wastes, 75% said they participate in such initiatives while 25% said they do not. The result reveals that where there are community initiatives for waste management in the study area, majority of respondents (75%) participate.

A general lack of community involvement, public awareness and information amongst inhabitants about the importance of proper urban waste management seems to be the main reason for widespread littering according to Dawnarain (2004).

4.5.3Willingness to Pay In Order to Improve on the Solid Waste Evacuation/Collection Service

Figure 4.5 shows the distribution of responses on willingness to pay for solid waste evacuation services.From figure 4.5, out of the 192 respondents that opined that they don't pay for their waste to be evacuated, 81.3% said they are willing to pay in order to improve on the waste evacuation services in their area while 3.7% of the respondents did not respond to the question

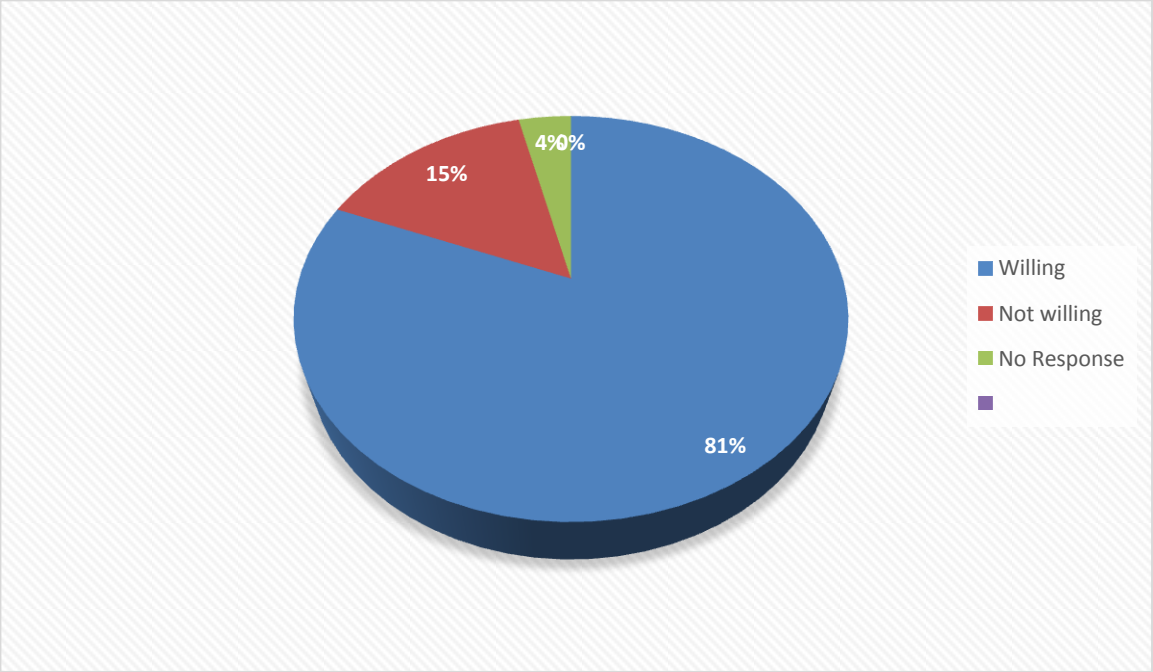


Figure 4.5: Willingness to pay for solid waste evacuation services

Source: Field survey, 2015

The result indicates that the majority of the respondents are willing to start paying for evacuation services in order to improve the service. This on the part of the respondents is a positive attitude towards solid waste management and if exploited well by BASEPA, will go a long way in improving solid waste management in the study area by generating much needed

revenue which can be used in other solid waste management ventures such as recycling and awareness campaigns.

4.5.4Separation of Waste and Participation in Other Waste Management Programmes Such As Recycling, Composting, etc.

Figure 4.6 shows the distribution of responses onwillingness to separate waste and participate in other solid waste management programmes

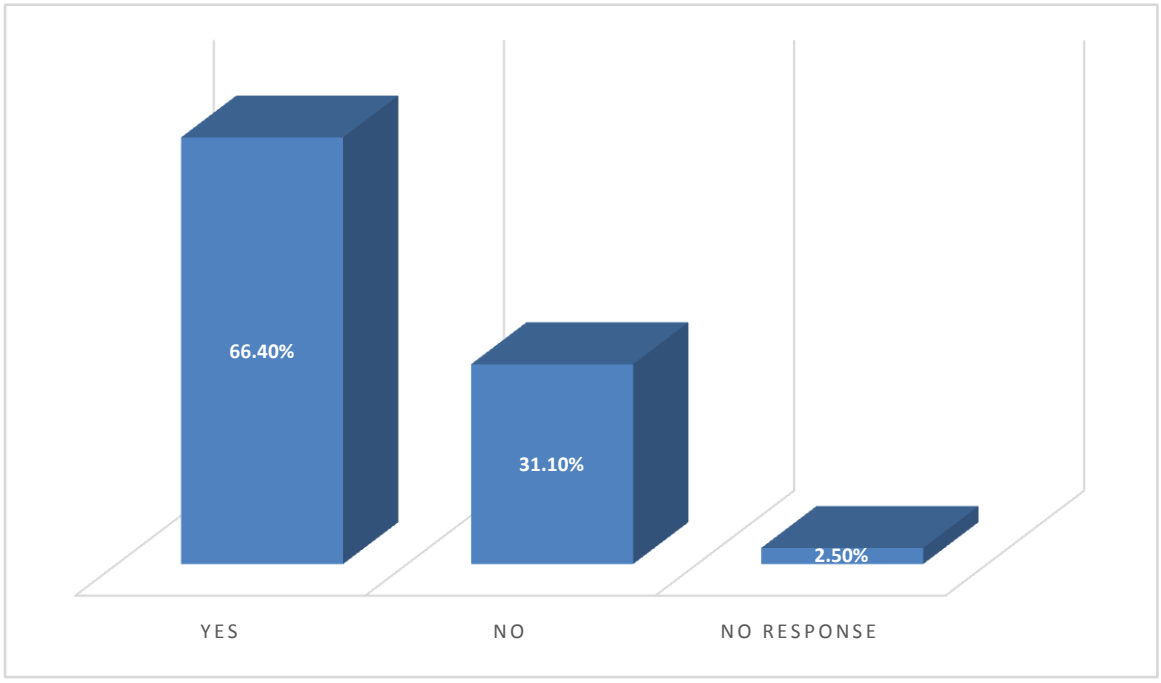


Figure 4.6: Willingness to separate waste and participate in other solid waste management programmes

Source: Field survey, 2015

Figure 4.6 indicates that 66.4% of the respondents said yes while 2.5% did not respond to the question. The result reveals that majority of the respondents were willing to separate their waste and participate in recycling, composting, etc. programmes.

BASEPA thus needs to introduce these techniques in the study area and create much awareness about them. This result clearly shows that given the necessary incentives and training, households will willingly engage in recycling, composting, etc. all processes which are important and necessary for effective Municipal Waste Management. For example, by composting solid waste, large amount of landfill air-space is conserved the leachate generated from the decomposition process is rendered less hazardous and the product, compost, is readily marketed for use by the agricultural industry and gardeners (Dawnarain, 2004).

4.5.5 Waste Management Technique besides Evacuation that Respondents will like to see put to use in their environment

Figure 4.7 shows the distribution of responses on waste management technique besides evacuation that respondents will like to see put to use in their environment. The result from figure 4.7 reveals that30.5% will like recycling to be put into use in their environment.Bunyard and Grenville(1990) stated thatan important way of reducing the impact of our consumer society on our environment is through recycling, which we, as consumers, must help to make work.Also, 26.7% will like to have a combination of two or more of the waste management techniques put into use in their environment.

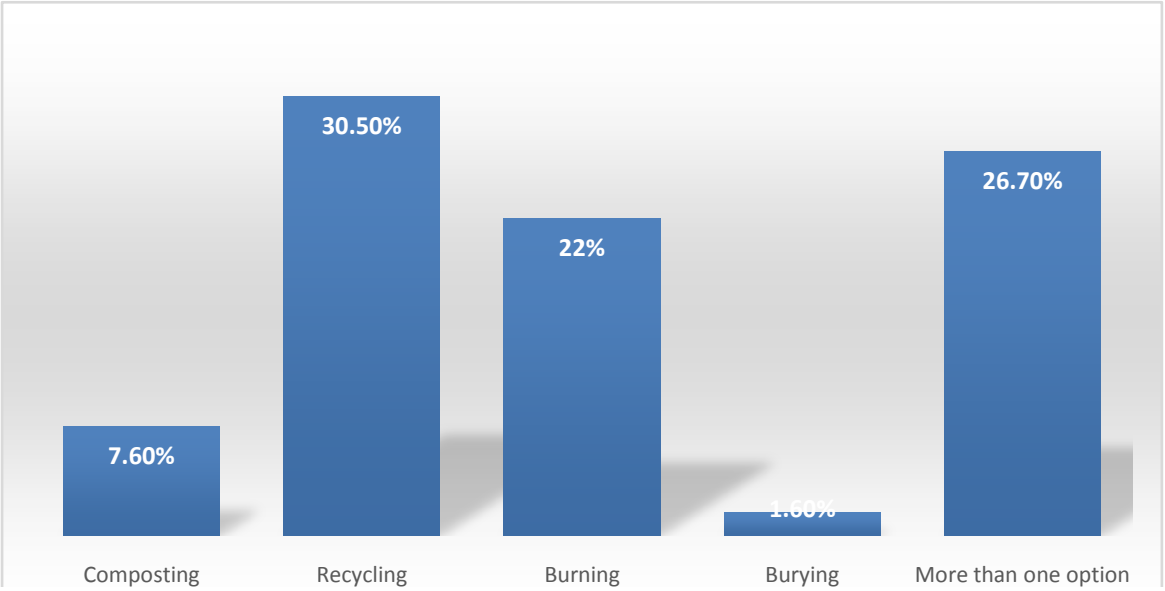


Figure 4.7 Waste management techniques besides evacuation that respondents will like to see put to use in their Environment

Source: Field survey, 2015

Recycling, composting, disposal and waste minimisation are often regarded as the techniques of Integrated Waste Management. An integratedWaste Management plan follows the life cycle of consumer products from cradle to grave, seeking to maximise the useful life of the resources (Tammemagi. 1999).The objective of an Integrated Waste Management Strategy (IWMS) is to minimise impact on the environment by employing all possible waste management technologies which can lead to effective Municipal solid waste management. Not all waste can be composted, and recycling or disposal in isolation cannot deal with all wastegenerated. The above mentioned techniques are thustermed integrated as it is important to promote all optionsin tandem i.e. if effective municipal waste management is to be achieved.

4.6 CONSTRAINTS TO EFFECTIVE MUNICIPAL SOLID WASTE MANAGEMENT IN BAUCHI METROPOLIS

Table 4.11 shows responses on constraints to MSWM in Bauchi metropolis.As shown in the Table, 17.8% indicated that inadequate funds is the main constraint to MSWM. The overall result however reveals that the constraints to MSWM in the study area are numerous as discussed:

Inadequate funds: though BASEPA did not disclose information of its financial allocation by the Bauchi State government, it claims inadequate budgetary allocation from the state government greatly limits its ability to carry out some of its solid waste management responsibilities and initiate policies such as recycling and from the result obtained, respondents seem to agree with the agency and this claim is supported by 17.8% of respondents. This claim is also supported by Babanyara and Bogoro (2011) where it is stated that budgetary grants from Bauchi State Government are the major source of funds for BASEPA and the grant is inadequate and normally delayed. The National Ecological fund according to the said study, occasionally assists the agency with equipment such as waste bins. Apart from that, BASEPA does not get any assistance/gift/ loan from any other source. This according to the study compels the agency to operate under difficult financial constraints.

Table 4.11Distribution of responses on constraints to effective MSWM in Bauchi metropolis

Variables	Frequency	Percentage (%)
Inadequate funds	57	17.9
Lack of modern landfills	42	13.2
Lack of cooperation and non-compliance by residents	41	12.9
Outdated and ineffective laws	32	10.1

Inadequate collection centers	29	9.1
Inadequate public awareness	26	8.2
Inconsistent and weak policies	23	7.2
Obsolete/inadequate plant and machinery	22	6.9
Inadequate community initiatives	17	5.4
Inadequate monitoring and supervision	15	4.7
Poor town planning	12	3.8
No response	2	0.6

Source: Field survey, 2015

Also, according to Baud and Schenk (1994) and Poswa (2000), usually, municipal fees in developing countries do not cover the operational costs of waste management services, and the available fund from the central budget is insufficient to finance adequate services to all segments of the population. Hence, in the developing communities solid waste services have suffered neglect and low prioritization compared to other municipal services.

Lack of Modern landfills for waste disposal was selected by 13.2% of respondents as a constraint to effective MSWM. Though a state capital, the study area does not have a single modern constructed landfill. All it has are three locations where wastes from the various parts of the town are dumped and burnt from time to time.

Lack of cooperation and non-compliance by residents of the town was selected by 12.9% of respondents as a constraint. BASEPA cites the non-cooperative attitude of the residents of the town as one of the constraints to effective solid waste management. This view as the result revealed, is also shared by a lot of respondents. People disposed their waste any how in defiance of the solid waste management laws.

Outdated and ineffective laws regulating the conduct of municipal solid waste management in Bauchi town was selected by 10.1% of the respondents: the edict still in use for regulating Municipal solid waste management activities in the study area (i.e. Edict No. 3 of 1997) was enacted in 1997 and since then it has not being reviewed. As such, the laws does not take into consideration the present situations on ground.For example the edict did not specifically state the punishment for various offences related to waste as such, the court/agency usually gives out judgements at its discretion. And most of the time, the punishments meted are not punitive enough stop offenders from committing the offence again or to deter would be offenders.

On collection centres, 9.1% indicated that, they are inadequate especially in the densely populated areas inside the city wall (Ganuwa): though BASEPA's designates locations it calls collection centres where solid wastes are disposed before final evacuation, these centres are grossly inadequate, in some areas, they are even non-existent. Hence, the proliferation of many illegal dumpsites in the study area

Inadequate public awareness was indicated by 8.2% of respondents as a constraint: BASEPA from the findings of this research does not embark on enlightenment campaigns to guide people and create awareness on solid waste management. As such, ignorance is rife amongst residents; most residence who poorly manage solid waste are oblivious of the harmful and the dangerous consequence of their actions. Also a lot of people are unaware of modern means of managing wastes such as recycling, composting, etc.Illiteracy is high in developing countries and waste management education occurs mostly in informal ways. Life styles and value systems, aspirations and behaviours, and level of education can play an important role in mismanagement of solid waste. Lack of general public awareness of waste management is result

of high levels of commingled waste and littering. Since people are not aware of disposal mechanisms, they simply throw all the waste together in un-segregated form. Fruits like oranges, mangoes, peas are eaten and the seeds and fruits remain litter in the streets. Banana peels, corn husks, and nutshells are scattered all over cities as residents simply throw them away anywhere any time (Onu, 2000).

Inconsistent and weak policies was selected by 7.2% of respondents. This constraint is to a large extent on the part of BASEPA. BASEPA's policy on waste disposal can at best be described as non-existent because all around the study area, you see people disposing wastes on streets, inside drainages, by the road sides; you see huge waste dumps near residential houses, etc. This, the research found out was due to a policy introduced around the year 2012 by the then state government allowing residents to dispose wastes in front of their homes/shops/offices for onward evacuation by BASEPA or its operatives. On evacuation, BASEPA's policy is reactionary i.e. it doesn't have a schedule on waste evacuation. Wastes are only evacuated when they pile up and constitute a nuisance or an important government function is to be held in vicinity.

Obsolete/inadequate plant machinery for effective municipal solid waste management as a constraint was selected by 6.9% of respondents. A lot of theequipment BASEPA uses for solid waste management have either broken down or are in a poor state, thus making effective management of solid waste difficult. Findings of this research reveals that, BASEPA's Waste compacting vehicles (four in number) are all in poor condition, the agency's three water tankers and a septic emptier though in better condition than the waste compactors are also not in good condition. The only Payloader is also in a poor condition and the agency's two tractors are both in fair condition according to BASEPA documents.

Inadequate community initiatives on MSWM in Bauchi metropolis was selected also a constraint:community initiatives on waste management are very necessary in order to achieve effective waste management. The task is enormous as such unachievable by government alone. Most of the time policy makers or local authorities don't involve the local communities in designing developmental programme or projects. However, as stated by Midgley, Hall, Hardiman and Narine (1986), the participation of the beneficiaries, i.e. the households, in most social or public programme or projects, is now generally accepted as a prerequisite for the ultimate acceptance and sustainability of such programme or project.

Inadequate monitoring and supervision by government was indicated by 4.7% of respondents as a constraint also**.**Waste management activities are not properly monitored in the study area. This is evident by the number of respondents who said they don't have sanitary inspectors and the manner in which waste is indiscriminately dispose around town. Also, the perception of the respondents with regards to BASEPA's administrative and organisational arrangement is lowest.

Poor town planningwas selected by 3.7% of respondents as a constraint also.The existing living condition in most parts of the study area is characterized by unplanned road networks/buildings units, lack of good drainage system, etc. all these impedes accessibility in terms of waste evacuation activities especially in densely populate areas of the metropolis. According to Usman and Mohammed (2012), apart from the old town most of the study area was laid out with a proper town plan and basic infrastructure, such as paved-roads, pipe borne water and good drainage system in some areas. However, due to the recent rapid growth in population, uncontrolled development began to take place. Plots of lands are subdivided into smaller units, houses are erected without approval, blocking access to infrastructures devel-

opment and indeed these posed difficulties in waste management services. Consequent upon these, heaps of refuse piled up in these areas, in drains, public spaces, uncompleted buildings and vacant plots.

Finally, although not stated by the agency and respondents, multiplicity of the several and sometimes conflicting schedules of BASEPA such as erosion control, preventing tree falling, ecological control and conservation, removal, destruction and or demolition of any stalls, shop, shed or any unauthorised structures from streets, high way nor other open places, etc. is definitely a constraint. Because the little resources and energy of BASEPA is clearly dissipated in too many things, most of which are discharged ineffectively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The aim of this study was to assess the effectiveness of the Bauchi State Environmental Protection Agency in municipal solid waste management in Bauchi metropolis.BASEPA's mandate is enshrined in the edict No.3 of 1997. Under the edict, BASEPA is the sole agency responsible for all matters relating to environmental protection, sanitation and environmental research in Bauchi metropolis. 66.4%of respondents dispose their solid wastes inside bins.

Majority of respondents (71.7%) had waste dumps in their areas, most of these dumps are situated by the roadside and they smell badly, obstruct traffic, block drainages and harbour insects.

Solid wastes in Bauchi metropolis were mostly evacuated by BASEPA, majority of the respondents were not paying for evacuation services and majority of respondents did not also separate their solid wastes before disposal. Also, 46.5% of the respondents did not have community initiatives in their areas for solid wastes management.About47.8% of the respondents reported that they did not have sanitary inspectors, for those who had, inspections were conducted monthly and defaulters were usually charged to court. BASEPA provides ancillary services such as street sweeping and drainage clearance mostly on a daily basis but does not provide recycling, composting and sorting services.

The Kruskal-Wallis H test revealed that there is a statistically significant difference in perception amongst the public with respect to the role of BASEPA in Municipal Solid Waste Management in Bauchi metropolis. The perception of the public with respect to BASEPA's administrative and organisational arrangements had the lowest mean score of 606.80.About 57.9% were not satisfied with BASEPA's solid waste management services and majority also blame BASEPA for the solid waste mismanagement in Bauchi metropolis.

Majority of respondents (81.3%) were willing to pay for solid waste evacuation, participate in other waste management activities in order to improve on solid waste management in the study area.Majority of respondents will also like recycling to be introduced as an alternative method of managing solid waste. Lastly, 17.8% of respondents opined that inadequate funds was the main constraint to municipal solid waste management in the study area. Other constraints include obsolete laws regulating the activities of the agency, weak and

inconsistent policies, lack of modern landfills, inadequate collection centres, obsolete and inadequate plant and machinery.

5.2 CONCLUSION

The findings of this study reveals that BASEPA is the sole government agency responsible for all matters relating to environmental protection, sanitation and environmental research in Bauchi metropolis and its mandate is enshrined in the edict No.3 of 1997. It can therefore be concluded that BASEPA's functions are multiple and divergent, also, the edict guiding municipal solid waste management in Bauchi metropolis is obsolete/outdated.

The study also revealed thatmajority of respondentsare not satisfied with BASEPA's solid waste management services and majority also blame BASEPA for the solid waste mismanagement in Bauchi metropolis. Thus it is clear that BASEPA's current MSWM approachis not effective.

From the result it can also be deduced that BASEPA's MSWM role in terms of addressing environmental issues in Bauchi metropolis with the highest mean score is perceived best by the respondents. BASEPA thus has to improve on its administrative and organisational arrangement in terms of its efficiency and effectiveness because it got the least mean score.
Finally, the findings revealed that majority of respondents cite inadequate funds as the major constraints to MSWM and a conclusion is made that inadequate funds is the ultimate hindrance to effective municipal solid waste management in Bauchi metropolis.

5.3 RECOMMENDATIONS

Base on the findings of this research, the following are recommended;

i. The edict guiding the conduct of BASEPA needs to be reviewed in order to streamline its mandate especially with regards to municipal solid waste management. The review can use as a model, the law establishing the Kano State Refuse Management Board (REMASAB) which was specifically established to guide the management of municipal solid waste.

ii. BASEPA should re strategize its administrative and organisational arrangements with regard to municipal solid waste management by properly scheduling asupervising such activities, being consistent in carrying out its policies and creating awareness on solid waste management in the study area. For example, evacuation of wastes should be conducted on a weekly basis not until when waste heaps have accumulated.

iii. Other management techniques like sorting, re use, recycling needs to be introduced by BASEPA if effective municipal solid waste management is to be achieved. This can be achieved in the short run by partnering with the Bauchi state waste recycling company in the area of recycling.

iv. Modern landfills should be constructed by the government so as to accommodate the increasing quantity of waste generated and checked the negative consequence of open dumping.

v. Awareness campaigns should be undertaken regularly in order to sensitise the public on the need to properly manage their waste and the consequences of not doing so. This can be achieved through media jingles, seminars and workshops.

vi. The policy of dumping wastes by the road side for it to be evacuated should be stopped. Instead, every building should be mandated to keep a waste bin to dispose their waste before it is evacuated.

vii. BASEPA should look into alternative source of funds such as introducing a fee for waste evacuation, taxing private waste management companies and stipulating fines on environmental law defaulters.

viii. BASEPA should engage the communities and encourage them to increase their participation in waste management activities through individual and collective initiatives.

ix. Sanitary inspectors should be assigned to all areas in the study area in order to monitor and regulate solid waste management activities. This can be achieved by employing more sanitary officers.

REFERENCES`

Abdullahi, M. B., Sanusi, S. S., Abdul, S. D., Sawa, F. B. J. (2009). An Assessment of the Herbaceous Species Vegetation of Yankari Game Reserve, Bauchi, Nigeria. *American – Eurasian Journal of Agriculture and Environmental Science, 6*(1), 20 – 25. Retrieved from idosi.org/aejaes/jaes6(1)/4.pdf

Adedibu, A. A. (1983, January). *Solid Waste Management in Nigeria and Prospects.* Paper presented at the National Conference on Development and the Environment, University of Ibadan, Ibadan, Nigeria.

Adora, O.A. (1997). Current State of the Art of Environmental Education in Nigeria. InLawal M.B and Mohammed A.A. (Eds). *Proceedings of the National Workshop on Popularising Environmental Education in Nigerian University*. University of Calabar, Nigeria.

Ahmed, M.I.(2007*). Introduction to Environmental Problems and Management*. ISBN 978-36411-0-7 Kano, Nigeria.

Attahi, K. (1999). Governance and waste management in Abidjan. In Onibokun, A. G. (Ed). (2004). *Managing the monster: Urban waste and governance in Africa.* Canada International Development Research Centre (IDRC). Retrieved from www.idrc.ca/publication/online books on 20 November, 2006.

Babalola, A., Ishaku, H.T., Busu, I. and Majid, M.R. (2010). The Practice and Challenges of Solid Waste Management in Damaturu, Yobe State, Nigeria. *Journal of Environmental Protection,* 1, 384-388. doi:10.4236/jep.2010.14044

Babanyara, Y.Y., Saleh, U. F. and Usman, H.A. (2010). An Overview of Urban Poverty and Environmental Problems in Nigeria. *Journal of Human Ecology,* 31(2), 135-143. Retrieved from http://www.google.com/search, 17 November, 2014.

Babanyara, Y.Y. and Bogoro, A.G. (2011).Evacuation of Solid Waste in Residential Areas of Bauchi Metropolis, Nigeria. *Journal of Environmental Sciences and Resource Management,* Vol. 3, 10-29. Retrieved from www.cenresinpub.org, 7 July, 2014.

Battaglia, M.P. (2008). Multi-Stage Sample. In P. J. Lavrakas (Ed), *Encyclopaedia of Survey Research Methods.*doi http://dx.doi.org/10.4135/9781412963947.

Bauchi. (2015). *Encyclopedia Britannica.* Retrieved October 17, 2015 from www.brittanica.com/place/Bauchi-Nigeria.

Bauchi State Environmental Protection and Conservation Agency Edict No.3 of 1997 (Bau) (Nig).

Baud, I. and Schenk, H.(1994). *Solid Waste Management Modes, Assessment, Appraisals and Linkages in Bangalore*. New Delhi: Manohar.

Baum B and Parker C, (1973). *Solid Waste Disposal, Incineration and Landfill*. Michigan: Ann Arbor Science.

Bowley, A.L.(1962). Measurement of the precision attained in Sampling. *Bulletin of the International Statistics Institute, 22*(1), 6 – 62.

Bunyard, P. and Morgan-Grenville, F. (1990). *The Green Alternative*. London: Mandarin.

Callan, S.J. and Thomas, J.M. (1996).*Environmental Economics*. London: Oxford University

Press.

Cable S, Cable C, (1995). *Environmental Problem's Grassroots Solutions: The politics of Grassroots environmental Conflict*. New York: St Martin press.

Chukwuemeka, E., Ugwu, J., and Igwegbe, D. (2012). Management and Development Implications of Solid Waste Management in Nigeria. *Asian Journal of Business Management* 4(4), 352-35.

Chuwang, B. Z. (1997).*An Appraisal of Refuse Management in the Makama Housung Upgrading Bauchi Town* (Unpublished Master's thesis). University of Jos, Nigeria.

Cointreau, S. (1996). *Sanitary land fill siting and criteria* (Urban No. UE-12). Washington DC, World Bank Infrastructure Notes.

Cornwell, D.(Ed.). (1998). *Introduction to environmental Engineering.*USA: McGraw-Hill Company.

Dawnarain, R. B. (2004). *An investigation of solid waste management Practices: The case of the Chatsworth township In Metropolitan Durban - Kwazulu-Natal* (Master's Thesis, University of Kwazulu – Natal, South Africa). Retrieved from researchspace.ukzn.ac.za.

Du Plessis, S.and Nero, H. (1991). Can Privatization Work?*Resource Journal of Waste Management,7* (I), 15-20.

Enger, E. D., and Smith, B. F. (Ed). (2006). *Environmental Science: A study of interrelationship*. New York, USA: McGraw-Hill Company.

European Environmental Agency, (2009). *Waste Framework Directive*(75/442/EEC, Art.1cd). Retrieved from ec.europa.eu/environment/waste/framework on 9 July, 2014.

Federal Environmental Protection Agency (FEPA). (1991). *Sustainable Development in Nigeria*. National Report for theUnited Nations Conference on Environment and Development, Rio de Janeiro, Brazil.

Federal Military Government 1988. *Federal Environmental Protection Agency Decree No. 58:* A 911– A 932.

Filani, M.O and Abumere, S.I. (1983). Solid Waste Generation in Selected Nigerian Cities.

Nigerian Geography Journal, 2, 13-18.

Fuggle, R.F. and Rabbie, M.A., 1992: *Environmental Management in South Africa.* Cape Town: Jutaand Co. Ltd.

Gani, B. A., Chiroma, A., Gana and A. B. (2012). Women and Solid Waste Segregation in Bauchi,Nigeria. *Journal of Environmental and Earth Science*, 2(8). Retrieved from www.iiste.org, 7 July, 2014

George, T. and Frank, K. (2002). *Handbook of Solid Waste Management.* USA. McGraw – Hill Companies, Inc.

Goldstein, J.(1969). *Garbage as you like it. A plan to stop pollution by using our nation's waste*. New York: Emmaus Parodale Books.

Habitat, A.(1993). *Refuse Collection Vehicles for Developing Countries*. Washington: United NationsCentre for Human Settlements.

Knox, B. (1988). *The Pit Sea Experience.* Proceedings of the International Conference of the Institute of Waste Management 9th Congress. Johannesburg, South Africa.

Lawson, F and Alston, I.(1989). *Landfill Microbiology* (Workshop report), United Kingdom: Department of Energy

Leton, T.G, Omotosho, O. (2004). Landfill Operations in the Higher Delta Region of Nigeria. *Journal of Engineering Geology*, 73 (1-2), 171-177.

Lubie, F. (1990). Bio-hazardous waste management. *Proceedings of the International Conference on Waste Management in the Nineties: 10th Congress of the Institute of Waste Management.* Johannesburg, South Africa.

Mabogunje, A. L. (1980, March). *Cities and Social Order***.**Paper presented at anInaugural Lecture of the University of Ibadan, Ibadan, Nigeria.

Maria, M. and Schienberg, A.(1997). *Gender and Urban Waste Management*. Paper presented at the Gender Technology and Development Conference organised by TOOL/TOOLCONULT, Amsterdam.

Midgley J., Hall, A., Hardiman, M. and Narine D. (1986). *Community Participation, Social Development and the State*. London: Methuen.

Nabegu, A.B. (2008). The Role of Refuse Management and Sanitation Board (REMASAB) In Solid Waste Management in Kano Metropolis. *Maiduguri Journal of Arts and Social Sciences,* 6(2), 33-36.

Nabegu, A. B. (2009). Municipal Solid Waste Management in Kano and Katsina cities: A Comparative Analysis. *Journal of Geography and Development. 2*(2), 20-24.

Nabegu, A.B and Mustapha, A. (2015). Institutional Constraints to Municipal Solid Waste Management in Kano Metropolis, Nigeria.*International Journal of Innovative Environmental Studies Research.* 3(3),13-21. Retrieved from www.seahipub.org.

National Population Commission (2009).*2006 Population and Housing Census report of the Federal Republic of Nigeria.* Retrieved fromhttp://www.population.gov.ng.Accessed.

Nigeria: People, Population and Settlement. (2003). Retrieved October 17, 2015, from www.onlinenigeria.com/links/bauchiadv.asp/blurb=201.

Nshimirimana, J. (2004). *Attitudes and behaviour of low-incomeHouseholds towards the management of Domestic solid waste in Tafelsig,Mitchell's plain*(Unpublished master's thesis. University of the Western Cape, South Africa.

Ogunyemi, B. (1997). Towards Better Management of Urban Waste in Nigeria: Environmental Education Approach. In Albert, I.O (Ed), *Processing of International Symposium on Urban Management and Urban Violence in Africa*, 1(1), 7-11.

Ogwuche, J.A. (2013). Spatial Location of Solid Waste Dumpsites and Collection Scheduling using the Geographic Information Systems in Bauchi Metropolis, Nigeria.*European Scientific Journal*, 9 (11), 374 -382. Retrieved from eujournal.org, 7 July,2014.

Ogwueleka, T.C. (2003). Analysis of Urban Solid Waste in Nsukka, Nigeria. *Journal of Solid Waste Technology and Management*, 29 (4*)*, 239-246.

Ogwueleka, T.C. (2009). Municipal Solid Waste Characteristics and Management in Nigeria. *Iran Journal of Environmental Health,Science and Engineering,*6 (3), 173-180.

Onibokun, A. G.(Ed). (2004). *Managing the monster: Urban waste and governance in Africa.* Retrieved from www.idrc.ca/publication/online books on 10th August, 2014.

Onu, C. (2000, September). *Sustainable waste management in developing countries*. Paper Presented at the 1st Biennial Conference and Exhibition of Somerset West, Cape Town, South Africa.

Orazulike, D. M. (Ed.). (1992).Expansive Soils: the silent hazard in Bauchi State, Nigeria. In Samuel, J. F., Ofoegbu, C. O., Onuoha, K. M. (Eds.). *International Earth Evolution Sciences Monogram Series* (pp. 163 – 173). Doi:10.1007/978-3-663-05239-5.

Organization for Economic Co-operation and Development (OECD). (2002*). Environmental Data Compendium* (Technical Report). Retrieved from http://ww.oecd.org/env/indicators-modelling-outlooks/oecdenvironmentaldatacompendium.htm, 17 July, 2014.

Polprasert C, (1996). *Organic Waste Recycling. Technology and Management*. Chichester: J. Wiley and Sons.

Poswa, T.T. (2000, September). *A holistic investigation into the effect of social and demographic factors in the planning of a domestic solid waste management system in developing urban areas*. A paper presented at the 1stBiennial Conference and Exhibition of Somerset West, Cape Town, South Africa.

Ramachandra, T.V. and Shruthi, B. (2007). Environmental Audit of Municipal Solid Waste Management. *International Journal of Environmental Technology and Management,* 7(4), 369-391.

Rand,T.,Haukohl, J. and Maxen, U. (2000). *Municipal Solid Waste Incineration: Requirements for a Successful Project* (World Bank Technical Paper 462).Washington DC: World Bank.

Rushton, L.(2010). *Health Hazard and Waste Management.* MRC Institute for Environment and Health, Leicester. UK.

Schubeler, P. (1996). *Conceptual Framework for Municipal Solid Waste Management in Low Income Countries.*UNDP/UNCHS(Habitat)/World Bank/SDC Collaborative programme on Municipal Solid Waste management in low income countries. Working paper No. 9.

Skinner, J. (1994). International progress in solid waste management, IWM Proceedings in

Dawnarain, R. B. (2004). *An investigation of solid waste management Practices: The case of the Chatsworth township In Metropolitan Durban - Kwazulu-Natal* (Master's Thesis, University of Kwazulu – Natal, South Africa). Retrieved from researchspace.ukzn.ac.za.

Solid Waste Management. (2008). Microsoft Encarta Dictionary. Redmond, WA, United State of America.

Sridhar, M.K.C and Adeoye, G.O. (2003). Organo-mineral Fertilizers from Urban Wastes: Development in Nigeria. *The Nigeria Field,* 68, 91-111.

Switzer J.V.(1994). *Environmental Politics: Domestic and Global Dimension*. New York: St Martin's Press.

Tammenagi, H. (1999). *The Waste Crisis, Landfills, Incinerators and the search for Sustainable future.* New York: Oxford University Press.

Tchobanoglous, G., Theisen, H., and Eliason, R. (1977). *Solid Wastes: Engineering Principles and Management issues*. USA: Mcgraw-Hill Publishing Company.

Tchobanoglous, G., Theisen, H., and Visil, S.A. (1993). *Integrated Solid Waste Management Engineering Principles and Management issues*. New York: McGraw Hill Inc.

Thomas-Hope, E. (1998). *Solid Waste Management Critical Issues for Developing Countries: A Project Guide*. Urban Development Department, World Bank. Retrieved from www.worldbank.org, 7th July, 2014.

United Nations Conference on Environment and Development, (1992).*Agenda21 Declaration.*Report of the UnitedNations Conference on Environment andDevelopment, Rio De Janeiro, Brazil, A/CONF.151/26 Vol.1). Retrieved from http://www.un.org/documents, 8th July, 2014.

United Nations Development Programme (UNDP). (2002*). Municipal Solid Waste Management in Developing Countries: A policy Framework* (Geneva Technical paper 12). Geneva: United Nations Development Programme Publication.

United Nations Environmental Programme (UNEP). (2002). *What is Integrated Solid Waste Management.* Retrieved August 24, 2015 from www.un.org.

United Nations Environmental Programme (UNEP). (2004). Municipal Solid Waste

Management in Developing Countries: A policy Framework. Geneva. Technical paper, 12, Geneva.

United Nations High Commission on Refugee Statistical Yearbook.(2006). *Bauchi Town*. Retrieved from www.unhcr.org on 12 November 2014.

United States Environmental Protection Agency (2002).*Solid Waste and Emergency Response* (EPA 530-F-02-026a (5306W)). United State of America: USEPA.

Usman, H.A, Mohammed, B.U.(2012). Solid Waste Management in Bauchi, Nigeria (Obstacles and prospects). *Journal of Environmental Science and Resources Management,* Vol. 4, 96-107. Retrieved from www.cenresinpub.org, 7 July,2014.

World Health Organization (WHO). (2003*). Health Hazards of Municipal Waste.* New York: World Health Organisation publication.

Yamene, T. (1976). Sampling method for determining population size. *International journal for statistical analysis.Vol.3*, 65 -67.

APPENDIX I

DEPARTMENT OF GEOGRAPHY

AHMADU BELLO UNIVERSITY, ZARIA.

Dear Respondent,

The researcher is a student of the above named Institution undertaking a research titled "Assessment of the effectiveness of the Bauchi State Environmental Protection Agency in Municipal Solid Waste Management in Bauchi Metropolis, Bauchi State,

Nigeria". The exercise is purely an academic work and all information will be treated as confidential and used for academic purpose.

Thank you for your assistance.

Please provide information or tick in the appropriate boxes to the following questions

SECTION A:Demographic andSocio-Economic Characteristics of Respondents

1. Age group of the respondent…… (a) 18-27 (b) 28-37 (c) 38-47 (d) 48-57 (e) 58-67 (f) 68 and above
2. Gender of respondent; Female / Male
3. Marital status: (a)Married (b)Not Married (c)Widowed (d)Divorced
4. Educational level: (a)Primary (b)Secondary (c)Tertiary (d)Others (specify)
5. How much do you earn monthly? (a) N18,000 or below (b) N19,000 – 50,000 (c) N51,000 – 82,000 (d) N83,000 – 114 (e) N115 and above
6. Number in household……..
7. Occupation…… (a)Farming (b)Trading/Business (c) Civil Service (d) Artisan (e) Others (specify)……

SECTION B: The extent to which BASEPA has achieved its mandate with respect to MSWM in Bauchi Metropolis

8. What is the name of the institution responsible for municipal solid waste management in Bauchi town?.....
9. How do you dispose your waste before it is evacuated? (a)Inside Dust bins/Containers (b) Buried by Household (c) Burnt by Household

(d) Public approved Dumps/Dump site (e) others specify……

10. Do you have dumps/dumpsites in your area? Yes / No

11. Where is/are the Dump(s)/Dumpsite(s)' in your area situated?

    a. On/by the road side/walk ways b. Far from buildings c. Near the buildings

    a. Inside drainages e. Others (specify)……

12. The dump(s)/dumpsite(s) in your area…… (you can tick more than one option)

    a. Smells badly

    b. Obstructs movement/traffic

    c. Blocks drainages

    d. Harbours disease causing vectors such as flies, mosquitoes, rats etc

    e. Others (specify)……..

13. Who evacuates/collects your Solid Waste?

    a. BASEPA operatives

    b. Private waste evacuation company

    c. Community effort/initiative

    d. Others (specify)……

14. Do you pay for your solid waste to be evacuated/collected? Yes / No

15. Do you sort/separate your waste before disposing them? Yes / No

16. Does your area/community have any kind of collective initiative on solid waste management?

    a. Yes b. No c. I don't know d. others (specify)……

17. If your answer in '16' above is 'Yes', do you participate in such initiatives?

Yes / No

18. Are there sanitary inspectors in charge of your area?

    a. Yes b. No c. I don't know d. Others (specify)……

19. If the answer to Question 18 is 'Yes', how often do they come around?

    a. Daily b. Weekly c. Monthly d. Others (state) ……

20. How do the sanitary inspectors deal with defaulters?

    a. They fine them b. They charge them to court c. They caution them d. The force them to conform e. Others (specify)……

21. Does BASEPA provide services such as street sweeping and drainage clearing in your area? Yes / No

22. How often are streets swept and drainages cleared in your area?

    b. Daily b. Weekly c. Monthly d. Others (state)…….

23. Besides waste evacuation, does BASEPA provides/assists in any other solid waste management technique e.g. separation/Sorting, recycling, composting, etc.?

    YES / NO

24. If the answer in Question '23' is 'Yes', state the waste management technique(s) and how BASEPA provides/assists in carrying it out……
    ……

25. Are you disturbed when you see people throwing wastes around inappropriately?

    Yes / No

26. What will you do if you see someone dumping waste in an inappropriate place e.g. inside the drainage, by the street, on pavements, etc.?

    a. Report him/ her

    b. Advise him/her against it

c. Do nothing

d. It is not a problem for me

e. Others (specify)……

SECTION C: Perception of the public with respect to the role of BASEPA in MSWM in Bauchi Metropolis

Questions	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
BASEPA'S Management of Municipal Solid Waste in Bauchi Metropolis represents an adequate administrative and organisational arrangement in terms of efficiency and effectiveness					
The Municipal Solid Waste Management system in Bauchi Metropolis is effective/efficient in terms of waste evacuation/collection and transfer/transportation.					
The Municipal Solid Waste Management system in Bauchi Metropolis meets the objective for waste prevention and control such as; minimization, recycling, energy/resource recovery and safe disposal facilities					

The present Municipal Solid Waste Management system in terms of addressing environmental issues in Bauchi metropolis is adequate					
The present Municipal Solid Waste Management system in terms of addressing health and safety issues in Bauchi metropolis is adequate					
The present Municipal Solid Waste Management system in Bauchi metropolis, provides income and employment opportunities					

27. Are you satisfied with the solid waste evacuation services provided? Yes/No

28. If you are not satisfied with the solid waste evacuation/collection services , please state your reason (you can tick more than one answer)

    a. Unreliability of service

    b. Low frequency of service

    c. Lack of clean appearance around the waste bin/area after evacuation

    d. High cost of evacuation services

    e. Others(specify) ……

29. Who in your opinion is most responsible for the problem of solid waste mismanagement in Bauchi Metropolis?
    a. Residents of the town
    b. BASEPA
    c. Private waste handling companies
    d. Others (specify)……..
30. Will you be willing to pay in order to improve on the waste evacuation/collection service in your area? Yes / No
31. Will you be willing to separate your waste and participate in other household waste management programmes such as recycling, composting, etc.?
    Yes / No
32. Which of the following waste management technique(s) besides evacuation/collection would you like to be put to use in your environment? (you can tick more than one)
    a. Composting b. Recycling c. Burning/Incineration d. Burying waste in pits e. Others (specify)……
33. Is solid waste managed properly in your area? Yes/No
34. Give reason(s) for your answer in Question 32 above……
    ……
35. What in your opinion is the major problem/constraint militating against effective Municipal Solid Waste Management in Bauchi Metropolis?.....
    .....
36. What can be done to make Municipal Solid Waste Management effective in Bauchi Metropolis as a whole?
    ……
    ……

APPENDIX II

INTERVIEW GUIDE

- What is your position in the Agency?
- How long have you been in the Agency?
- When was BASEPA established?
- Why was it established?

- Was BASEPA established by law?
- If yes are the laws adequate to allow for efficient operations?
- Are you aware of other regulations by Federal and local authorities with regards to Municipal Solid Waste Management?
- What is the organisational structure of BASEPA?
- What is BASEPA's mandate with respect Municipal Waste Management in Bauchi Metropolis?
- What strategies/methods does BASEPA use to achieve its mandate with respect to Municipal Solid Waste Management in Bauchi Metropolis?
- What are the challenges you encounter in the course of carrying out your job?
- To what extent has BASEPA achieved its Mandate in the area of Municipal Solid Waste Management?
- What are the future plans of BASEPA with regards to the managing of municipal solid waste in Bauchi metropolis?
- What are the aspirations of BASEPA with regards to the managing of municipal solid waste in Bauchi metropolis?
- What are the constraints to effective Municipal Solid Waste Management in Bauchi metropolis?
- What can be done to achieve effective Municipal Solid Waste Management in Bauchi metropolis?