EXPLORING THE POSSIBILITY OF DEVELOPING AN EFFECTIVE SOLID WASTE MANAGEMENT PRACTICES FOR TWO TOWNS IN SARAWAK : AN ACTION RESEARCH STUDY

Being submitted as partial requirement for the degree of Master of Science (Human Resource Development)

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Biographical Sketch

Bujang bin Haji Budin was born on 3rd August 1961 at Kampung Sileng Melayu, Lundu. He went to Bumiputera Primary School, Lundu Secondary School and Kolej Tun Abdul Razak for his early education. In 1981, he enrolled as an undergraduate at the University of Malaya where he earned a Bachelor of Arts (Honours) degree in 1984. He has been serving the State Civil Service for fourteen years as an Administrative Officer, and has served at various stations in the state. Presently he is an Assistant Secretary in charge of development at the Ministry of Environment and Public Health, Sarawak.

This study is dedicated to my late father Haji Budin bin Mahmud and my mother Hajah Raipah binti Deris

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ABSTRACT

The study on solid waste management focuses on the need to have a clean environment for Lundu and Sematan towns. Both towns were found to be dirty due to the fact that rubbish and garbage were not disposed properly. The lack of facilities such as garbage bins coupled with a poor solid waste management system practised by Lundu District Council had caused both towns to be in an unkempt condition. The concern of the community leaders, government officials and the general public on the poor condition of both towns prompted this study to be carried out.

In conducting this study, the researcher and five other senior members of the council formed an action research group. The main objectives of this group were to identify ways to solve the impending problems of poor solid waste management, to identify workable practices that could help in improving the condition of both towns, to identify new learning practices on solid waste management among the group members that could be transferred and used at the workplace and finally to work as a team in solving problems and making decision pertaining to solid waste management. The group held four meetings to discuss, analyze and agree to the solutions that were best suited for both towns. In action research, the group was focused on the problem where decisions were arrived at through brainstorming during the action research group's meetings. In the process, group members acquire new skills and knowledge that could enhance their performance.

From the various discussions held in a cyclical process, the group agreed on the following findings that could be implemented by the council. The findings of the group were as follows;

1. The council should allocate more bins at both towns.
2. Proper waste collection time and schedule should be implemented.
3. The collection of garbage should be done based on the collection routes to reduce travelling time.
4. The council must implement solid waste zoning system to encourage public participation in solid waste management.
5. The use of a centralised collection station at villages and residential areas would enhance a cleaner environment.
6. The sweeping of both towns should be done regularly.
7. The council should establish Solid Waste Management Committees as venues for discussion on proper solid waste practices.

The action research group recommended that the council should prepare strategic, tactical and operational plans to implement the findings. The strategic plan should cover a period of within five years or more where focus should be made on the following matters- to start recycling program, to have a proper sanitary landfill, to replace obsolete equipment and to prepare a comprehensive human resources program geared towards efficient solid waste management. The tactical program could be implemented within a period of less than five years. This should cover the following areas- to increase the area of solid waste coverage and to encourage greater public participation on solid waste management. The operational plan emphasized on the following areas- proper solid waste collection, the use of mobile garbage bins at all locations, the establishment of a solid waste management committee, improvement work on the landfills, regular street sweeping, the need to use plastic bags, the placing of bins at roadsides, the need for council to put up more billboards on solid waste, the need for the council to train staff on proper solid waste management, the need for the council to implement the centralised collection system, the council to provide a safe and healthy working environment, and the need for the council to implement the route system for solid waste collection.

ABSTRAK

Kajian keatas pengurusan sisa pepejal memberi tumpuan kepada keperluan mengujudkan alam sekitar yang bersih di pekan Lundu dan Sematan. Kedua buah pekan didapati kotor akibat daripada pembuangan sampah yang tidak sempurna. Kekurangan kemudahan seperti tong-tong sampah dan sistem pengurusan sisa pepejal yang tidak cekap oleh Majlis Daerah Lundu membawa kepada kedua buah pekan menjadi kotor. Keprihatinan pemimpin masyarakat, pegawai-pegawai kerajaan dan orang ramai mengenai kekotoran kedua buah pekan tersebut menyebabkan kajian ini dijalankan.

Di dalam menjalankan kajian ini, penyelidik dan lima orang pegawai kanan majlis menubuhkan kumpulan kajian bertindak. Objektif utama kumpulan ini ialah mengenalpasti cara mengatasi masalah pengurusan sisa pepejal, mengenalpasti amalan-amalan yang praktikal dalam membantu membaiki keadaan kedua buah pekan, mengenalpasti amalan-amalan baru mengenai pengurusan sisa pepejal yang boleh digunakan di tempat kerja dan seterusnya bekerja secara berpasukan di dalam menyelesaikan masalah dan membuat keputusan berhubung dengan pengurusan sisa pepejal. Kumpulan ini mengadakan empat mesyuarat untuk membincang, menganalisa dan bersetuju kepada rumusan yang paling sesuai untuk kedua buah pekan. Di dalam kajian bertindak, kumpulan ini memberi tumpuan kepada masalah dimana keputusan dibuat secara brainstorming semasa bermesyuarat. Di dalam proses ini, ahli kumpulan mendapat kemahiran dan ilmu pengetahuan yang baru bagi membaiki prestasi diri.

Dari beberapa perbincangan yang diadakan secara proses cyclical, kumpulan ini bersetuju mengenai penemuan-penemuan berikut yang boleh dilaksanakan oleh pihak majlis.
Penemuan-penemuan ini ialah;

1. Pihak majlis hendaklah menyediakan lebih banyak tong-tong sampah di kedua buah pekan.
2. Masa punggutan sampah yang sesuai hendaklah dilaksanakan.
3. Punggutan sampah hendaklah dibuat mengikut laluan-laluan punggutan bagi mengurangkan masa perjalanan.
4. Pihak majlis hendaklah melaksanakan sistem zon sisa pepejal bagi menggalakkan penyertaan orang awam di dalam pengurusan sisa pepejal.
5. Penggunaan stesyen punggutan berpusat di kampung-kampung dan kawasan penempatan akan membawa kepada alam sekitar yang bersih.
6. Kedua buah pekan hendaklah disapu selalu.
7. Pihak majlis hendaklah mengujudkan Jawatankuasa Pengurusan Sisa Pepejal sebagai saluran untuk perbincangan mengenai pengurusan sisa pepejal.

Kumpulan kajian bertindak menyarankan agar pihak majlis menyediakan pelan-pelan strategik, taktikal dan operasional bagi melaksanakan penemuan-penemuan ini. Pelan strategik seharusnya meliputi jangka masa lima tahun atau lebih dimana fokus hendaklah diberikan kepada perkara berikut- memulakan program kitar semula, menyediakan tempat pembuangan sampah sanitari, menggantikan peralatan yang lama dan mengadakan program komprehensif pembangunan sumber manusia kearah pengurusan sisa pepejal yang cekap. Program taktikal boleh dilaksanakan dalam masa kurang dari lima tahun. Ianya meliputi perkara berikut- menambah kawasan liputan sisa pepejal dan menggalakkan penyertaan orang awam di dalam pengurusan sisa pepejal. Pelan operasional pula menekan kepada perkara berikut- punggutan sampah yang cekap, penggunaan tong-tong sampah beroda di semua lokasi, mengujudkan jawatankuasa pengurusan sisa pepejal, membaiki tempat pembuangan sampah, pekan hendaklah disapu selalu, keperluan penggunaan bag plastik, meletakkan tong-tong sampah di tepi jalan, menyediakan papan-papan tanda mengenai sisa pepejal, keperluan latihan kakitangan di dalam pengurusan sisa pepejal, pelaksanaan sistem punggutan berpusat, pihak majlis menyediakan persekitaran kerja yang selamat dan sihat, dan keperluan melaksanakan sistem laluan di dalam punggutan sampah.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.0 Introduction

This chapter will discuss on the background of the client organization that is Lundu District Council, where this study was being done. It will also describe the background and the reasons why the study was being done.

1.1 Background of the study

The roles played by a local authority were described as protective, communal, personal and trading (Seeley, 1978, p. 37). By protective, it meant that the provision of services were in the form of drainage and refuse disposal, where the services were meant for the protection of the public. Communal services were the provision of street lighting, public reading rooms, bus waiting sheds or any services that served the communities tangibly. The personal and trading services were not provided by the local authorities in Sarawak. Personal services were activities such as education and welfare, while trading activities were real businesslike in nature such as supply of water or electricity.

The Public Health section is responsible for the protective services where solid waste management is one of the most important activity. Actual revenue generated from solid waste management in 1996 was RM 33,135.00 where 62.46 percent was from the rate-payers , while 37.54 percent was payment made by the government. It was noted that while this was a revenue-generating activity, but the expenses incurred by the council on the management of solid waste was pretty high. In the same year, a total of RM 284,269.00 was spent on the management of solid waste, second only to the expenses incurred on the payment of wages. (Annual Financial Statement for Lundu District Council 1996).

As at 31st December 1997, a total of 557 out of 4445 households in Lundu District and Sematan Sub-District were being provided with scavenging or solid waste management service. This represented a small fraction of the households which was only 10.17 percent. Only 4033 people out of 24,599 people in the district or 16.39 percent were getting the service.(Public Health section, Lundu District Council). The concentration of the service was confined mainly to town areas and areas adjacent to the town, or only when there were requests from the rate-payers for such service. The places being served with the service, based on the 1997 records obtained from the Public Health section of the council, were as follows;

Lundu Town

(a) Government Buildings and Quarters

(i.)Federal Buildings and Quarters (93 units)

(ii.)State Buildings and Quarters (109 units)

The total number of units or buildings served were 202, while the number of people being provided with the service were 1536 persons.

(b) Residential and Villages

(i.) Kampung Sileng (30 units)

(ii.) Kampung Sebemban (7 units)
(iii.) Kampung Pulo Air (4 units)
(iv.) Kampung Sungai Lundu (9 units)
(v.) Kampung Kedaong (8 units)
(vi.) Lundu Bazaar (60 units)
(vii.) Lundu Town Zone (38 units), and
(viii.) Jalan Melintang (17 units)
The total number of units or houses being served were 173, while the number of people being provided with the service were 2463 persons.

Sematan Town
(a) Government Buildings and Quarters
(i.) Sematan Government Secondary School (24 units)
(ii.) Primary School (7 units)
(iii.) Army Camp (1 unit)
(iv.) Public Library (1 unit)
(v.) Lundu District Council Barrack (2 units)
(vi.) Government Clinic (6 units)
(vii.) SESCO and Telecom office and quarters (8 units)
(viii.) Fishery Department's quarters (5 units)
(ix.) Pueh Youth Camp (12 units), and
(x.) Sematan Sub-District office and quarters (6 units)
(xi.) Police Barrack (4 units)
(xii.) Markets and Stalls (3 units)
The total number of houses served were 79, while the number of people getting the service were 955 persons.

(b) Residential and Villages
(i.) Residential lots and Shophouses (73 units)
(ii.) Kampung Pueh (21 units)
(iii.) Kampung Sebat Dayak (11 units)
The number of houses being served were 105, while the number of people getting the service were 615 persons. Rural areas were not served with the services partly because of inaccessibility, and thus they only paid for the general purpose rate. The rate charged by the Council on solid waste management was fixed at 4.5 percent against the assessment rate.(Sarawak Government Gazette. LG 3 dated 18.1.1996).

In dealing with solid waste management, the Council had three compactor trucks equipped with lifting devices at the rear for easy placement of garbage bins onto the trucks . A total of 6 employees were directly involved in the scavenging activities where three were contracted workers while the other three were permanent council employees. A team of 3 employees comprising of a driver and two packers or laborers were assigned to collect and dispose garbage at Lundu and Sematan towns. One truck was not used but kept in the office at Lundu in case the other two trucks broke down. The solid wastes which consisted of households wastes, commercial wastes, papers, metals and other non hazardous wastes were placed in mobile garbage bins, bulk bins and standing bins at

roadsides for easy collection. These wastes were then sent to the landfills at Stunggang dumping ground at Lundu which had an area of more or less 9.43 acres, and at Kampung Sebat dumping ground at Sematan which had an area of more or less 6.91 acres for composting. Both these landfills are located on state land, and has life spans of 13 years for Stunggang dumping ground, and 10 years for the Kampung Sebat dumping ground. None of the solid waste was recycled or reused. The acquisition of land for both sites were made possible from fund received from the state government in 1990 for the Stunggang landfill , and in 1996 for the Kampung Sebat landfill.

The management of solid wastes was amongst one of the major activities of a Local Authority. Under the Local Authorities Ordinance 1996, section 104(a) and section 104(f) (ii) provide that a local authority shall have the power

a) to establish, maintain and carry out such sanitary services for the removal and destruction of, or otherwise dealing with, night-soil, slops, rubbish, litter, dead animals and all kinds of refuse, waste and effluent;

b) to safeguard and promote the public health and to take all necessary and reasonably practicable measures for maintaining its area in a clean and sanitary condition.

While managing solid wastes, a local authority is further given the power under section 105 of the same ordinance, from time to time make, amend or revoke by-laws for the better carrying out of the provisions of the aforesaid ordinance

Thus from the power given by the Local Authorities Ordinance 1996, the local authorities are the authorities that manage and carry out the function of solid waste management with a view to safeguard and promote public health.

Solid wastes are the useless, unwanted, or discarded materials which consist of agricultural wastes, commercial wastes (that are generated by stores, offices and other activities that do not turn out a product), industrial wastes (resulting from manufacturing and industrial processes), and municipal or household wastes which are mainly domestic in nature (Kupchella and Hyland,1993: 471).

Thus solid wastes are any substances which constitute scrap material, effluent and other unwanted surplus substances arising from the application of a process, substance or article which requires to be disposed of as being broken, worn out, contaminated or spoiled (Read, Paul and Guy, 1997, p.184). These substances can be categorized as wood, cardboard, paper, plastic, glass, metal, organic matter, meat and various (Norrie, Lafortune and Beauchamp: 267-269) .

For the purpose of this study, municipal solid wastes and domestic wastes would be discussed in chapter four. The study was done within a 5 kilometer radius for Lundu town and 12.5 kilometer radius for Sematan town.

The provision of section 104 of the Local Authorities Ordinance 1996 which empowers the local authority in carrying out the function of solid waste management would be the guideline of the study.

1.3 **Background Of The Client Organisation**

This study would focus on the roles and responsibilities of Lundu District Council in the management of solid waste in Lundu District, particularly for Lundu and Sematan towns.

For general information, Lundu district had a population of 24,599 people (Department of Statistic Malaysia, 1991). Out of this 2,463 people were residing in Lundu town and 1,570 were residing in Sematan town (Lundu District Council, 1996) . The total rateable properties of the district were 4,445 in 1996, where 891 properties were located in Lundu and Sematan towns (Ministry of Environment,

Kuching, 1997). The size of the district is approximately 1812.3 square kilometers (Annual Report, Department of Land and Survey, Sarawak, 1987). It is located approximately 95 kilometers from Kuching, the state capital. Basically Lundu District is a rural district.

Lundu District Council

Lundu District Council was established under the Local Authorities Ordinance 1948. A local authority is a corporate body whereby its members or " Councillors " are appointed by the government, and decisions are made by members in a full council meeting.

The Council has 25 members comprising of a Chairman and 24 Councillors. (Sarawak Government Gazette, Volume .L 21 September 1995). The District Officer is the chairman of the Council. Each member or Councillor serves for a period of two years. The main role of the Councillors is to set policies during the full council meetings which meet four times a year . These policies are to be adopted and implemented by the Council.

1.3.1 **The Roles and Responsibilities of the Council**

The Council is run by administrative officers headed by a Secretary. Lundu District Council has 54 permanent staffs which are distributed into four major sections which are discussed below ;

(a) Administration

This section deals with general administration in the council area of jurisdiction. This involves providing services to the public (rate payers) in the form of setting public libraries and reading rooms, enforcement of council by- laws and ordinances, and the planning and management of the human resources. It is also responsible for managing the financial aspects of the council.

(b) Public Works

This section deals with planning and development of the Council annual development projects where funds are made available through grants from the federal and state governments, while minor projects are funded by the council itself.

(c) Rating and Valuation

The core activities of this section are the preparation and administration of annual assessment rates for all properties, and keeping up- to- date records of properties within the local authority area. Properties that are for use as charitable, religious and educational purposes are exempted from rates.

(d) Public Health

The main activity of this section is the promotion of public health through the maintenance of cleanliness and public hygiene. This is done through food and vector control, solid waste management, and maintenance of public places such as the toilets, markets, and animals slaughter sites .

1.3.2 **Revenue and Expenditure of the Council**

(a) Sources of Revenue

Like every local authority, Lundu District Council generates its income by providing services to the rate payers. The sources of income falls into two categories which are;

i. the income generates by the Council through the imposition of rates, licenses, fees, and miscellaneous charges, and

ii. the annual grants given by the state and federal governments.

Based on the Annual Financial Statement of 1996 for Lundu District Council, it received a total of RM 2,813,859.00 in revenue from both sources. These revenues were in the form of rates (RM 217,287.00), licenses (RM 43,285.00), miscellaneous charges (RM 160,937.00), government contribution and development projects (RM 2,404,460.00). Therefore government contribution toward the Council's revenue accounted for 80.54 percent of the total income. This contribution is important for the council to provide, improve, upgrade and maintain the services for the rate-payers.

(b) Forms of Expenditure

In order to provide good services to the rate-payers, Lundu District Council spent more than what it earned. In 1996 , the total expenditure was RM 3,067,953.00 . This situation caused a severe deficit of RM 254,094.00 (Annual Financial Statement for Lundu District Council,1996).

The main items that constituted the expenditure were personnel emolument, transportation, payment of utilities (electricity, water and telephone bills), maintenance of markets, slaughter sites, public toilets, solid waste management, and office expenses.

The expenditure of every section based on the Annual Financial Statement of 1996 for Lundu District Council were as follows;

i. Administration section spent RM 643,017.00,
ii. Public Health section spent RM 434,925.00,
iii. Public Works section spent RM 456,187.00, and
iv. the expenditure on development projects was approximately in the region of RM 1,533,824.00.

(c) Human Resources

Employees of a local authority are directly recruited by the organization once the request for the creation of new posts, or filling of vacant posts are approved by the Ministry of Environment Sarawak after consultation with the State Secretary's office. The filling of new or vacant posts are conducted through newspaper advertisement where job descriptions and qualifications are mentioned to enable potential applicants to understand the nature of the jobs and the requirement needed. A committee comprising of Councillors would conduct interviews to assess the eligibility of the candidates. Like all other government services, local authorities employees, under section 38 of the Local Authorities Ordinance 1996, are subject to transfer, posted or seconded to another local authority.

As at 9th June 1997, Lundu District Council had 54 permanent staffs. Out of this, 22 persons were in Administration, 2 persons were in Valuation, 13 persons were in Public Works, and 17 persons were in Public Health. The expenditure incurred in 1996 for the payment of salary of the employees was RM 888,536.00 (Annual Financial Statement for Lundu District Council 1996). This amount represented 31.58 percent of the total expenditure of the Council for that year. Every year the expenses on personnel emolument increased .

1.4 Problem Statement

The lack of a sound and effective solid waste management practices by Lundu District Council for Lundu and Sematan towns had resulted in both towns to be in an unclean situation. The justification of the study was reflected by the views, observations, and events taking place at both towns through the following factors;

1.4.1 The need for cleaner towns had often been voiced by community leaders, and discussed at the Lundu District Council meetings. Hence, there was a need to clean the towns, and to educate the public on having a sound waste management system.
1.4.2 From observations made by the researcher during regular visits to both towns while conducting this study, and written documents at the district council, this problem was most serious within five kilometer radius of the towns, in particular at the nearby villages and the towns themselves.
1.4.3 The concern of the Minister of Environment, Sarawak over the poor management of solid waste in the state by the local authorities, and the dirty situation of most towns, had prompted the Ministry of Environment Sarawak to organize towns cleanliness competition annually.

1.5 Objectives of the study

This study attempted to address issues pertaining to the management of solid wastes which consisted of municipal and domestic solid wastes by Lundu District Council with the following objectives;
1.5.1 To develop effective solid waste management practices for Lundu and Sematan towns by Lundu District Council to ensure that both towns are clean and beautiful.
1.5.2 To create public awareness in helping to keep both towns clean by way of a collaborative and participative involvement between the public in general and Lundu District Council in solid waste management.

1.6 Significant of the study

This study would form the guidelines in developing policies and practices on the management of solid wastes by Lundu District Council. In view that the management of solid wastes is the sole responsibility of the local authorities, therefore a sound solid waste management practices would be pertinent to deal with problems arising from mismanagement of solid waste.
It is also important for the other local authorities in the state to adopt the practices formulated in this study to standardize the operation by all local authorities. With the increase in solid waste annually, then strategic planning by having a sound waste management programs is important to create a clean and healthy environment. For Lundu District Council, this study would help in developing a sound solid waste management practices in future through the following ways;

1.6.1 This study enabled the Council, and the public to understand their roles in minimizing waste at source, in disposing waste at proper waste disposal facilities, and in educating the public on the need to keep a clean and healthy environment.

1.6.2 The health of the people of both towns would be enhanced through minimizing the risk of diseases originating from unhygienic conditions.

1.6.3 In human resource development, this study will provide the guideline for Lundu District Council in preparing training, educational and development programs pertaining to solid waste management for its staff. Under the training program, the Council could identify the various methods and models that are being practised worldwide in managing solid waste that are suitable for them. The selection of staff for training will be determined by their job descriptions and the tasks assigned to them. This will allow the Council to set aside adequate training fund for this purpose. However through the action research group, the group members which are

senior officials of the Council, would acquire new skill, knowledge and ideas on solid waste management as new methods on waste management are discussed by the group. Learning takes place as group members are exposed to new things that dwell with solid waste management, thus this will broaden their knowledge on the subject matter. The most important aspect of this study is to create self awareness among the public in general on the responsibilities that they need to play in keeping both towns clean. Through the various programs and activities being worked out by the Council, public participation in solid waste management is utmost important. The awareness and the education programs on solid waste management that need public involvement will determine the success of this program as proposed by the Council.

1.6 Definition of terms used in this study

The terms used in this study are defined based on their usage and the meaning assigned to them in the dictionary.

Annual assessment rate: The yearly rate imposed by the Local Authorities on premises in their area of jurisdiction. The rate is based on the annual rateable value of the property.

Bulk-bin: Huge garbage container that can hold garbage at more than 680 litres in capacity.

Councillor: A person appointed by the government from among members of the ruling parties to sit as executive members of the Council.

Commercial waste: Solid wastes that derive from commercial activities such as paperboard etc.

Domestic waste: Solid wastes that derive from households such as kitchen wastes, food leftovers etc.

Earthfilling: A process of levelling solid wastes at landfill by compactor machine. Top soil is used to cover the land once it is levelled.

Garbage: Unwanted materials that could not be re- used.

Incinerator: A specially built machine used to burn solid wastes.

Kerbside: The placement of garbage bins at roadside or road shoulder.

Methane: Gas emitted from landfills.

Packer: A person employed by the Local Authorities to collect and dispose off solid wastes.

Putrescible: Materials or food items that could easily rot.

Rodents: Animals that feed on garbage at the landfills such as rats etc.

Scavenger: A person that collect useable items or materials from the landfills.

Thematic concern: A concern that is shared by many which can effect the life of the whole community of people.

Valuer: A person employed by the Council whose responsibility is to assess the amount of rate that can be imposed on a property.

1.8 Limitations of the study

The limitations of the study were due to the fact that the researcher was new in the field of Action Research. He managed to gather some invaluable knowledge on action research during a brief seminar at the Gibaran Action Research Management Institute in Adelaide, Australia in December 1997. Apart from that, the study was conducted within four months starting from 7th January 1998 until 20th April 1998. The researcher had to travel very often to Lundu from his

residence in Kuching. He had to divide his time between lectures at Universiti Malaysia Sarawak (UNIMAS), and conducting research at Lundu. However, the negotiation with the client's organisation on the field of study pertaining to solid waste management took up a lot of the researcher's time. It was finally agreed during a briefing on the 7th January 1998 where research subjects would be discussed during the action research group meetings.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter will look into solid waste management that might be applicable to the study. The various solid waste management systems on how wastes were being managed and treated would be viewed. This management system consisted of solid waste generation, collection of solid waste, transfer and transport of wastes, disposal of wastes, and the management of landfill. The types of solid wastes would also be looked into to determine the kind of management systems applicable to the study.

2.1 Literature On Solid Waste Management

A number of studies and researches had been conducted all over the world on the management of solid waste with the purpose of developing a sound solid waste management system.

2.1.1 Definition of solid waste

To put it in a simple way, according to Pfeffer (1992: 2) solid waste "*... is any solid material in the material flow pattern that is rejected by society.*"

However a definition made by Tchobanoglous , Hilary and Samuel,(1993: 3) on solid waste is

"*... all the wastes arising from human and animal activities that are normally solid and that are discarded as useless or unwanted.*"

Solid waste has caused much concern to the public in relation to the effect it can cause to the environment and the public health if poorly handled. There are three ways where waste can be disposed. The medium of disposal are land, air and ocean. Through the use of landfills, solid waste is disposed on the ground, either covered by soil or left to decompose. The use of incinerators will transmit gases and smoke to the air which eventually cause air pollution. Hazardous waste or radio-active waste is put into the ocean which after a number of years, through wear and tear, will effect marine resources.

2.1.2 Types of Solid Waste

Pfeffer (1992: 4-7) categorises solid waste into four categories which are municipal waste, domestic waste, industrial waste, commercial waste, and agriculture residues.

(a). Municipal wastes are the solid residue that result from municipal functions and services. These include street refuse, dead animals, abandoned vehicles, water and sewage plant residues, park and beach refuse, and landscape waste.

(b). Domestic waste is rejected solid material that originate from households. These include garbage, rubbish, ashes and bulky wastes.

(c). Commercial waste consists of refuse originating from offices, banks, schools, hospitals and so on.

(d). Industrial waste consists of refuse generated at industrial sites, commercial component, and the process solid waste. There are of two types which are commercial refuse, and process waste (this is the residue remaining from manufacturing processes).

(e). Agriculture residues are solid residues resulting from agricultural activities. These include animal feeding and crop residues.

2.2 Solid Waste Management Methods.

The main issues in the management of wastes are those relating to the sources of wastes and the amount of wastes being generated. This will then relate to the need for the disposal of wastes especially with the facilities available and where they should be located.

In view of that, some aspects of waste management that need to be looked into are the four hierarchies of waste management;

(a) Reduce- This requires the reduction of waste at source, and the society has to be educated to produce less waste.

(b) Reuse- This requires that a certain amount of waste can be reused. The idea seems odd and rather provocative.

(c) Recycle- Waste can be separated into items that can be recycled such as paper, glass, metals, woods and compost. Different waste streams are created to recycle waste, but the markets for such products might be difficult to find.

(d) Recovery- The use of incinerators and landfills fall into this category, which is the last resort in waste management.

Kent (1992: 153) suggested that disposal for hazardous waste should be done at secured landfills and treatment facilities such as high temperature incinerators to burn waste.

2.2.1 Elements of Solid Waste Management System

In managing solid waste, Tchobanoglous *et al* (1993: 10- 15) explained in detail the six functional elements of a waste management system. This system consists of;

(a) Waste Generation- This encompasses activities where materials are identified as no longer of use and thrown away. This activity is beyond control which ultimately resulted in more waste being discarded or produced.

(b) Waste handling and separation- This involves the management of waste until they are placed in storage containers for collection. Handling involves the movement of loaded containers to the collection points. However separation is a process where wastes are separated based on its materials or components such as bottles, cardboards and so on. The best place for separation to be done is at home where solid waste originate.

(c) Collection- Basically this process involves the gathering and transporting of solid wastes to locations where the collection vehicles are emptied. This location may be a processing facility, a transfer stations or a landfill disposal site.

(d) Transformation of solid waste- Transformation processes are used to reduce the volume and weight of waste requiring disposal, while at the same time to recover conversion product and energy. Transformation of organic municipal solid waste can be done through chemical or biological processes.

(e) Transfer and Transport- This involves two stages which are (1) the transfer of waste from smaller collection vehicle to a larger one, and (2) the subsequent transport of waste over long distances for processing or disposal.

(f) Disposal- This is the final functional element in the solid waste management system. Most solid wastes are disposed off at landfills, while a smaller fractions are being incinerated or recycled.

2.3 Solid Waste Disposal Methods

2.3.1 Landfill As A Disposal Method

Landfill is the most commonly used method for waste disposal. Landfills are the physical facilities used for the disposal of solid waste on the surface soil of the earth. According to Tchobanoglous *et al* (1993: 371) there are three classifications of landfill based on their usage which are Type I for hazardous waste, Type II for Designated waste, and Type III for Municipal Solid waste. The principal methods used for landfilling of municipal waste are excavated trench, area method, and canyon method.

However writers such as, Graham Smith (1993: 162-163) looked into the advantages and the disadvantages of the landfills as the most common waste disposal practices in the world.

Advantages of landfills

The advantages of the landfills as waste disposal facilities are;

(a) It provides improvement in public health from sanitary disposal.
(b) It is easy to operate and very flexible in operation.
(c) It is an economical means of disposal.
(d) If it is properly operated and designed, landfills have little environmental impact.
(e) Land after being used as landfills can be rehabilitated or developed as recreational land for golf course, parks and others.

Disadvantages of the landfills

(a) The location of landfills will be determined by the administrative, political, economical and social considerations.
(b) It is found that environmental protection measures such as the prevention of leachate, and the control of methane gas are expensive.
(c) Normally landfills require a sizeable amount of land.

2.3.2 Study on landfill usage in England

Read, Phillips and Alice,(1997: 154-181), conducted a study on the use of landfills in two English cities of Northampton and Surrey. Both these cities had large population where Northampton had 578,807 people and Surrey had one million people. The findings from the study showed that;

(a) Northampton produced 1.8 million tons of all types of wastes a year where 658,000 were inert, 772,000 trade, 375,000 putrescible, and 250,000 household. The city has nine landfills which are useable until the year 2006.
(b) Surrey produced 2.7 million tons of waste a year consisting of household, commercial and industrial wastes. Out of these wastes, household waste accounted for 500,000 tons. The city has 136 sites for waste disposal, waste treatment or waste storage.

The study was done to look into the future role of landfill management and proposals were put up to both city councils where landfill tax could be introduced to minimize waste at source, prevent pollution, and reduced need for landfills. Thus in 1995, United Kingdom introduced landfill tax based on weight at seven pounds per ton for non inert waste (households) and two pounds per ton for inert waste. The idea was to reduce landfill, and find other methods for waste management such as reuse, recycle and waste minimization.

Northampton County Council was in favor that landfill operators to pay for the tax, while Surrey County Council gave no indication to adopt the landfill tax. The use of landfill tax to minimize waste going to the landfills were practiced in other European countries such as Denmark, France, Germany, Belgium and The Netherlands

2.3.3 **The Love Canal Case**

The Love Canal was a landfill in Niagara falls, New York. For a number of years, the Hooker Chemical Company disposed its waste in 55 gallons drum in the landfill and then covered with clay. In 1952, the landfill which was no longer in use, was sold to the Board of Education of Niagara Falls. A school and few houses were built on the site. Only twenty five years latter that wastes begun to leach, and leachate penetrated into basement, backyards and into the air. An estimate of over 300 chemicals were identified, and suspected carcinogens. The residents complained of the situation, and in 1978, it was declared a federal emergency area. The United States government spent $ 250 million to clean up the place. (Kupchella and Hyland, 1993,p 404-405).

2.3.4 **Environmental Impacts of landfills**

Though landfills continue to be the most attractive disposal route for solid waste where almost 95 percent generated world - wide is currently disposed, the potential hazard arising from mismanagement of it can cause untoward concern to the societies (Mutassem, Angelos,and James, 1997,p.1). Among the major hazards from landfills are landfill gas formation, leachate formation, fire and explosion, unpleasant odors, ground water pollution, air pollution, and global warming. These has direct impact on the environment and the people living within it. Based on the study made by Mutassem *et al* (1997:1-17), the following findings on landfills' hazards are traced;

(a) Landfill gas formation

Oxygen depletion within the landfill marks the onset of the anaerobic decomposition phase. Landfill gas is highly dependent on the decomposition stage within the landfill. By far the two principal components of landfill gas and form 90 percent of the total gas generated are methane and carbon dioxide. These gases are dangerous, and can cause severe fire and explosion.

(b) Leachate formation

Leachate formation is caused by the removal of soluble compounds by the non - uniform and intermittent percolation of water through the waste mass. The sources of percolating water are through precipitation, irrigation, and runoff. The quantity of leachate being generated depend on the site, the availability of water, the weather conditions, and the characteristics of the waste, the landfill surface and the underlying soil.

(c) Fire and explosion hazards

Landfill gas (methane and carbon dioxide) moves along routes to escape from the landfill either by venting through the cover or by moving through the sides to the surrounding soil. Depending on the soil characteristics, the gas may travel long distances away from the landfill. Incidents of fires and explosions can happen due to lateral gas migration away from landfills.

(d) Unpleasant odors

Odors are mainly the result of the presence of small concentrations of constituents in landfill gas that are emitted into the air. Though this smell or odors are not likely to cause health problem, but it is a nuisance to people living near the landfill.

(e) Ground water pollution

Leachate is by far the most significant threat to ground water. It travels laterally to a point where it discharges to the ground's surface as a seep, or it will move through the base of the landfill into the subsurface formations. It can contaminate aquifers underlying landfills.

(f) Air pollution

Although methane and carbon dioxide are the two major components of the gas emitted from landfills, other chemicals in landfill gas can be caused by households and light industrial wastes, or illegal dumping. Potential emissions of volatile organic compounds (VOC) from landfills can cause risk of cancer due to ambient ozone formation.

(g) Global warming

Emissions of methane and carbon dioxide from landfill surfaces contribute significantly to global warming or the greenhouse effect. Atmospheric methane concentrations were reported to increase at an average rate of about 1 to 2 percent per year. It is estimated that methane contributes about 18 percent towards total global warming. Thus, solid waste landfills are now becoming a significant contributor to atmospheric methane, unless recovery control systems are implemented.

2.3.5 **Incinerator**

Incineration is not a new technology. It has been used in Europe and the United States for a number of years. The major benefits of incineration are that the process destroys all of the waste rather than disposing it. In municipal solid waste incineration, the application of combustion processes under controlled conditions to convert wastes containing hazardous materials to inert mineral residues and gases. According to Theodore M.K and Theodore L (1996,p.192) there are four factors that influence incineration. These factors are;

(a) Free oxygen must be available in the combustion zone,
(b) The constant mixing of waste and oxygen must exist,
(c) Combustion temperatures must be maintained to provide enough heat to burn all organic components, and
(d) Transport of the burning mixture through high temperature region must occur over a sufficient period of time.

Municipal solid waste can be combusted in bulk form or reduced form. The types of incinerators used in municipal waste combustion are fluidized bed incinerators, rotary waterwall combustors, reciprocating grate systems, and modular incinerators. However, though incinerators are efficient method in waste disposal, the air pollution control requirements must be observed. According to Pfeffer (1992:196-201) air pollution control systems should take into consideration the following factors;

(a) Particulates - They are the result of solid materials that are present in the refuse or condense from organic vapours or metal fumes. These solid consists of inorganic oxides which are emitted over a wide range of particle sizes. There are two ways for control of particulate emissions from incineration which are electrostatic

precipitators (ESP) and fabric filters. ESP uses electrical field to remove the particles that acquire a charge when passing through this field. Fabric filters are closely woven fabrics that trap the particles as the gas stream is pulled through the filter.

(b) Acid gas control - Acid gases create operational and environmental problems. They must be converted to a solid by precipitation or absorbed by a solid or liquid particle. These particles are them removed by an appropriate removal devices.

(c) Dioxin control - Control of dioxin can be done by maintaining good temperatures and oxygen concentrations. In Italy combustion chambers are added to conventional incinerators to provide better control of the temperature and the oxygen level. The chambers provide a retention time of 2.0 seconds while the temperature is maintained at 1700 to 1800 degree Fahrenheit, and the oxygen is 6 percent at the chamber exit.

(d) Ash disposal - The bottom ash and fly ash from an incineration system contain all of the metals present in the refuse. Most of the ashes are sent to landfill for disposal though some are hazardous in nature. Thus in this situation ashes are required to be disposed ast hazardous waste sites.

2.4 **Recent study on Municipal Solid Waste**

Norrie , Lafortune and Beauchamp,(1997: 266-277), conducted a study in Quebec City (Canada), which had a population of 650,000 people, to assess nine supermarkets in the management of municipal waste. Based on the study, collection of waste was done every week. Waste were sorted into nine categories which were wood, cardboard, organic matter, paper, plastic, glass, metal, meat and various. To determine the amount of waste being produced by the supermarkets, the weight of each truck was recorded before and after unloading. Also recorded were the weight of the sorted waste products, whereby percentages of material sorted from each truckload were taken both on weight and volume basis. The evaluation on waste materials were found that the combination of cardboard, paper and wood took up 43 percent on weight and 74 percent on volume, while the combination of fruits, vegetables, pastries and baked goods took up 40 percent on weight and 10 percent on volume. It was plastics that took up the less in both weight (7 percent) and volume (13 percent). The study also discovered that 50 percent of the wastes were recycled, thereby reducing the volume of waste going to landfills or incinerators.

2.4.1 **Waste management at slums in Ecuador**

A study on the collection of municipal solid waste was done by Stern, Douglas and John,(1997: 119-224) at Machala, Ecuador.

Machala is a port city with a population of approximately 200,000 people. Half of the population lived in slums and no garbage services were provided by the city council. Every year the city council spent almost $ 500,000 on solid waste operations, and the city had only one landfill which had been used for 15 years. Residents living in slums disposed of their garbage on vacant lands and swamps. This interfered with the drainage system, thus creating stagnant water where mosquitoes and other rodents bred. To ease the problems of waste at slums, the city council privatized domestic waste collection at slum areas to a company, Microlimpia, in 1996. This company used tricycle operators to collect garbage at points not accessible by trucks to transfer points where five tons mini trucks transported garbage from transfer points to the dump. The use of tricycles as means of collecting garbage was practiced in other Latin American countries such

as Colombia and Peru. Based on the finding of the study, this is probably the best way to provide solid waste services to the residents of the slums and areas where roads are not passable by compactor-truck.

2.5 Solid Waste Recycling

Based on the study by Waite (1995: 3), he stated that the European Community (EC) strategy for waste management in 1990 were based on the following order;

(a) waste minimization
(b) reuse
(c) recycle
(d) energy recovery from waste
(e) safe disposal through the use of incinerators and landfills

In waste management, the three phases of sound activities are waste collection, waste disposal, and recycling. In this sense, if waste is not recycled, then the least that we should do is to recover the energy content of the waste prior to disposal through the medium of incineration. In the process of recycling, certain waste can be recycled and others can not. Those waste that can be recycled fall into three broad categories;

(a.) dry recyclables- paper, cardboard, glass, plastics, metals and textiles
(b.) organic material- kitchen waste and garden waste
(c.) miscellaneous materials- furniture and white goods (Waite,1995,p.21)

Waste that cannot be recycled in practice due to a number of reasons are;

(a) some material is too contaminated, for example food waste
(b) some material exists as mixed products, for example composite packaging
(c) some items are physically too small to be economically separated at a sorting plant, or
(d) even though the material can be separated, there is no market for it.

2.5.1 The Recycling Processes

In the recycling process as one of the options in waste management, solid waste can be divided into two categories;

(a.) dry recyclables- comprising of paper, plastics, metals, glass and textiles
(b.) organics- consisting of food and garden waste.

Dry recyclables materials can be separated either at source, that is by the households, into individual materials for collection and reprocessing. However, organic material can be treated in two ways which are by;

(a.) composting - this is a process by which the material undergoes a controlled, natural decomposition to produce a dry, odourless and friable organic material, which is suitable for soil uses.
(b.) anaerobic digestion - a technique in which the material undergoes a natural process of decomposition, but in the absence of oxygen. This process producers methane gas which can be used as a fuel source. (Waite,1995,p.35)

Before recycling can take place, the mode of waste collection, separation and processing must be considered first. Municipal or domestic waste is collected in three ways which can facilitate recycling;

from resource recovery, energy recovery can be done at locations where there are high concentration of wastes. These are done through energy recovery by incinerators where heat produced from burning wastes can be used to convert water into steam which can then be turned into running a turbine to produce electricity. This was practiced in Europe during the second world war, and places like Frankfurt in Germany, and Amsterdam in Holland produce some of their electricity by this way. In the United States some 128 waste-to-energy incinerators were in operation in the 1990's which produced equivalent of 30 million barrels per year.

However many factors are involved in successfully initiating and operating high technology resource facilities. Factors like a stable and dependable market, incentives in recycling industry, characteristics of locations, public acceptance of a resource recovery project, financial constraint, lack of expertise in local governments in resource recovery, and small municipalities/councils may not produce enough waste to support a resource recovery facility.

2.7 **Solid Waste Management Models**

Solid waste will be difficult to decrease since it is essentially coupled to the size of the human population and their food habits. Therefore in trying to handle this situation, several studies were done to find ways to manage the amount of solid waste for disposal.

2.7.1 **The ORWARE Model**

This study known as ORWARE (ORganic WAste REsearch) was done in Sweden, and had several components of different solid waste handling systems such as incineration, landfilling, anaerobic digestion, and composting. The wastewater components of ORWARE consisted of sewage plant and source separation of urine (Dalemo, Sonesson, Bjorklund, Mingarini, Frostell, Jonsson, Nybrant, Sundqvist and Thyselius, 1997:39).

The inputs to the system were waste flow (from kitchens, industries and others) and energy (fuel and electricity). Within the system there were different waste treatment processes and transport. The outputs were emissions (to the air, water and soil), energy (biogas, electricity and heat) and residues containing plant nutrients. The treatment processes and handling were collection and transportation by trucks, transport in sewers, a sewage treatment process, incineration, landfilling, composting, anaerobic digestion, and application of residual products on farm land.

Dalemo *et al* (1997: 41) reported that the objective of the project was to study the handling of the organic waste in Uppsala, a city in Sweden. The project covers the transportation to collect waste to be sent to the treatment plant for processing, then transported the residual product to farm land or to the landfills for unwanted residues. The waste in the project came from the households, gardens, parks, restaurants, trade, bakeries, grease water, and wastewater.

Under this model, five different scenarios were developed, which were;

(a.) Scenario 1 - the organic solid waste was incinerated. The wastewater was treated in the sewage plant, and the grease water was put in landfill.

(b.) Scenario 2 - the organic solid waste was landfilled. The wastewater was treated in the sewage plant.

(c.) Scenario 3 - Municipal source - separated solid organic waste and grease water were fermented in an anaerobic digester for production of biogas. The wastewater was treated conventionally.

2.5.1.1 **Paper**

Preparation starts with pulping, in which the paper fibres are separated by agitation in water. After pulping, the stock is screened to remove contaminants using coarse screening to remove large contaminants and fine screening to remove finer material. Once this is done, chemical treatment is applied to reduce the size into a finished paper.

2.5.1.2 **Glass**

The glass passes under an electromagnet which removes ferrous contaminants and through a manual sorting operation where plastic or aluminum bottle tops and non - glass items are removed. The glass (cullet) is crushed to uniform size, then electromagnet, before passing into bulk storage.

2.5.1.3 **Cans**

Cans are delivered to the plant as bales. These bales are shredded to less than 75 mm in size and distributed on the conveyor for the electromagnet separator. The cleaned material is transported to the melting furnaces for the production of aluminum ingot.

2.5.1.4 **Plastics**

Plastics are classed as either rigid or film. The baled plastic materials are broken, then granulated and washed to remove non - plastic contaminants. The separation process involves two techniques which are sink- float and hydrocyclones. The final process is the recompounding where addictives are mixed to produce a final pellet called regranulate.

2.5.1.5 **Textiles**

The processing is essentially a manual sorting operation to produce three streams of material to be used as;

(a). second - hand clothing,

(b). industrial wiping cloths,

(c). filling materials.

Clothing is sorted by garment type and quality so that suitable quality for reuse are segregated and baled for sale.

2.5.1.6 **Organic material**

The organic solid waste from households are in the form of kitchen waste, garden waste and industrially processed material such as paper and leather. The two methods of processing are composting and anaerobic digestion. Composting is a natural process of decomposition which occurs in the presence of oxygen and water. This will generate heat as it is exorthermic.

Anaerobic digestion is a method of energy recovery. It is a process involving the decomposition of organic material in the absence of oxygen. The process produces carbon dioxide and methane gas, and a residue called digestate.

2.6 **Energy Recovery**

Charles and Hyland, (1993: 479), stated that waste can be used as energy and material resources. Resource recovery can begin at home where waste or discarded materials like paper, glass , aluminum and other non organic materials are sorted out into recycling facilities, which later can be reused as other products. Apart

from resource recovery, energy recovery can be done at locations where there are high concentration of wastes. These are done through energy recovery by incinerators where heat produced from burning wastes can be used to convert water into steam which can then be turned into running a turbine to produce electricity. This was practiced in Europe during the second world war, and places like Frankfurt in Germany, and Amsterdam in Holland produce some of their electricity by this way. In the United States some 128 waste-to-energy incinerators were in operation in the 1990's which produced equivalent of 30 million barrels per year.

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(c.) Scenario 3 - Municipal source - separated solid organic waste and grease water were fermented in an anaerobic digester for production of biogas. The wastewater was treated conventionally.

(d.) Scenario 4 - composting of source- separated organic waste in a reactor compost with exhaust gas purification. The wastewater was treated conventionally.

(e.) Scenario 5 - was a variation of model 1. The stored urine was used on arable land without treatment and the faeces fraction was treated in the sewage plant. (Dalemo *et al*, 1997: 43).

The incineration model produced the largest net gain of heat. The slag from the incineration contained plant nutrients in concentrated form, but nitrogen in the waste was lost to the atmosphere. The composting model produced the smallest energy conversion. In the anaerobic digestion model, biogas and nutrients were produced when a substrate is anaerobically digested. The process needed extra heat to hygienise some incoming waste fraction, while the urine separation model is rich in plant nutrients. The study also showed that the emissions of substances with global warming potential are lowest for biological treatment of organic waste. The landfilled model emitted large amount of greenhouse gases due to the landfill process, where organic waste degraded and emitted methane. The study found that the health effects from handling organic waste were originated mainly from air emissions (from sewage plant), where as the contributions from soil and water pollution are negligible. The urine source - separation model where human urine, contained by far, the largest amount of plant nutrients, could be used on farm land, though not treated. (Dalemo *et al*,1997: 44-53).

2.7.2 **Mathematical Model**

This model can be classified into two categories which are (1) method for the collection of waste management, and (2) method for selection of transfer stations, incinerators and other plants. (Gottinger, 1991:12). The collection method deals with the problem of locating garages where collection trucks leave and to where they return. In this case, Gottinger (1991: 13) pointed that the important factors that need to be considered are (1) fixed costs of constructing a garage, (2) variable cost of a garage depending on the number of trucks, and (3) transportation cost from the garage to the collection points.

The second method deals with the problem of transporting wastes from transfer stations to landfill sites at a minimum cost if wastes are transported in aggregate amount by using bigger vehicles. In this case the transfer stations are assumed to have a fixed cost and a linear processing cost, and wastes from the sources are routed through transfer stations or directly to landfills. (Gottinger, 1991: 15).

2.7.3 **Computer Simulation Model**

In this model, the amount of wastes generated, efficiency of collection crew, and speed of trucks are considered when designing and analyzing a collection system. This model requires statistical information. The data required for the simulation are the boundaries of the area together with the population density, frequency of collection, truck capacity, location of transfer stations, size and type of trailers used (if any), location of disposal site, wages of laborers, distribution functions for collection rates, average number of persons per household, amortization interest rate of equipment, capital investment in land for transfer stations, hourly operating costs for truck-trailers, and monthly cost of utilities for transfer stations. (Gottinger, 1991: 18).

2.7.4 **Route Generation Model**

This model addresses how individual routes and assignment of crews may be determined. The fact that there are many possible and feasible routes in solid waste collection is solved by breaking areas into sub-areas involving very small collection tasks, and then determining the best ways of combining them into daily or weekly crew assignments. Important factors to be considered are crew size, vehicle size, pick up time and street networks. For single- route, the objective is to find the minimum distance that the collection crew would follow to reach a collection point. This is known as a " travelling salesman problem ". As a contrast to this approach is the " chinese postman problem " where the distance is a continuos tour through a network which travels all arcs at least once. Thus the differences between the two approaches are the " travelling salesman problem " is a node covering method, while the " chinese postman problem " is an arc covering problem. (Gottinger, 1991: 19-20).

2.8 **Conclusion**

In implementing a sound solid waste management practices for Lundu and Sematan towns, the waste collection and disposal methods would need greater attention. For Lundu District Council, landfills still remain the best option in waste disposal system. A detailed account from literature on landfill management is deemed important in helping to develop a proper solid waste disposal facility. It is cheap where there is abundant land, and the amount of solid waste generated by the public is relatively small. The use of incinerator is deemed not practical at the moment due to the high cost of installation, and Council staff will need to be trained to administer it.

The concept of waste reduction at source will only be possible if the general public is aware of their responsibility in managing their own solid waste. To do this public awareness campaign and public education program on proper solid waste management will have to be done by the Council. However, waste recycling is a program that the council will need to seriously look into. This will ensure that only non - recyclable waste goes to the landfills, while recyclable waste can be recycled.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

This chapter will describe the Action Research methodology and the research techniques being used in carrying out the solid waste management practices for Lundu and Sematan towns.

3.1 Purpose of the study

The study intended to explore the development of an effective waste management practices at both towns as a case study. This would be attained by answering the following research questions;

(a.) What are the current level of satisfaction in regard to solid waste management at both towns?

(b.) What are the critical factors involved in an effective solid waste management practices for both towns?

(c.) To what extend are Lundu District Council and the general public involved in solid waste management in both towns aware of the dimensions of solid waste management?

(d.) What are the level of readiness of Lundu District Council in contributing to the improvement on solid waste management at both towns?

3.2 Thematic Concern

The responsibility for solid waste management in Lundu district was entrusted to the Lundu District Council. The Public Health section of the Council played the most important role in solid waste collection and disposal. It also managed the landfills at both towns.

The volume of waste collected at both towns in a day was less than seven tons which comprised of the domestic and commercial waste. Most of the wastes were put in medium and big wheeled bins at strategic places such as the markets, bus terminals, and along roadsides within three to twelve kilometers from the towns. Nevertheless a substantial amount of solid wastes, in particular papers, plastic wrappers, plastic bags, and wooden boxes in medium sizes, were thrown indiscriminately at five- foot ways, drains, roadsides, and green open spaces at both towns. The scavenging units of the Public Health section would have to collect the waste, sweep the towns and place them in big plastic containers in the morning before loading them onto the trucks. This took between two to three hours work in the morning. The units normally started work at five in the morning at Lundu town, and six in the morning at Sematan town. Wastes were then transported to landfills some distance away from the towns for disposal. The amount of waste increased during weekends as tourists flock to both towns, and there were limited number of bins for waste disposal.

It was pertinent that a study of this nature to be carried out with a view to solve the problem of solid waste being discarded indiscriminately by the public at large, and to look into possible measures to address the issue of waste collection and disposal. Therefore, in trying to address this issue, the thematic concern of the general public, community leaders and government officials on poor solid waste management were focused on;

(a.) The development of this study would enable the council and the public to understand their roles in minimizing waste at source, in disposing waste at

waste disposal facilities, and in educating the public on the need to keep both towns clean, healthy, and beautiful.

(b.) The people of both towns, being directly in contact with the waste, would be exposed to risk of diseases originating from unhygienic conditions.

(c.) The roles played by the community leaders in voicing their concern over the poor waste management system, and the meetings held at Lundu District Council, prompted a need for a clean town. Follow - up actions should be done to ensure the town cleanliness being maintained at all time.

(d.) From observations made by officers from the Ministry of Environment Sarawak during regular visits to both towns on official duty, this problem was serious within five kilometer radius of the towns, in particular at nearby villages and the towns themselves.

3.3 Methods of the study

This study was done by using the Action Research method. In the study the Action Learning principles were looked into to understand the concept that learning took place in the Action Research Group, and that the transfer of learning would enhance the understanding of the action research group members while this study was being done.

3.4 Justification for the use of Action Research Methodology

In conducting the research on exploring the development of an effective solid waste management practices for Lundu and Sematan towns, action research method was used.

In action research, learning took place as group members became a learning group. They contributed ideas and knowledge for learning to take place with a view to address real-problem in our everyday life. This was done by way of brainstorming in a series of group meetings or discussions.
Therefore in looking for solutions to problems pertaining to the development of a sound solid waste management practices, the action research group deployed action learning within the action research process to arrive at effective and practical solutions to address the issue.

3.4.1 An Overview on Action Learning

It was through the work of Reg Revans, which started the idea some twenty years ago, by using a method in developing managers to focus on their own live experiences rather than looking at case studies on how managers behaved in other situation.(Mumford,1991:33)

Action Learning being a part of action research in the study, dwelt on real life problems as new knowledge and skills were gained along the way while doing the job, subject to certain pressures. The whole idea of action learning was to transfer learning problem as people learned while they were doing the job. This involved a group of people working together for a concentrated period of time, based on the relationship between reflection and action.

Action learning was a continuos process of learning and reflection supported by colleagues with an intention of getting things done.(McGill and Beaty, 1992:17). It was a process where the underlying factor was a belief in the individual potential's learning from the actions by means of questioning and reflecting, in order to gain insights, and thus enable the individual to act in future.(Weinsten, 1995:9).

3.4.2 Learning in Action Research Group

The learning project agreed by the group members was to find solutions to address issue relating to the poor solid waste management practices at both towns.This project was a specific problem or thematic concern to all group members and the general public. The project was real and alive. The members must be able to comprehend and act upon the problem with the intention to empower members with the learning process during the discussions, and thereby resulting in the transfer of learning. (McGill and Beaty,1992: 21)

An action learning group in this study were senior members of Lundu District Council who were also the members of the action research group. This group was facilitated by a facilitator. In this study the facilitator was the researcher. Group meetings were not conducted formally like any other meetings where there was a chairperson, written agenda, or minutes of discussions. The outcomes of the discussions were merely the actions agreed by all group members, who acted as a resource to each other. The main objective was to help each member to solve his problems with the support of the other members. Thus, a group could focus learning either on one person only or the group as a whole where the issues discussed were confidential. The group consisted a small number of six people. A bigger group would create tensions and stresses where members do not get a chance to talk, or contribute to the discussions and deliberations of the learning set.(Weinsten,1995:95). Regular meetings of the group was vital to discuss issues quickly, and the place of meetings should be convenient to all members since some members might be living far away from each other. To be effective, group members must be committed to the objectives of the group, and were able to contribute in the discussions.

It was deemed important that the learning styles of the members were taken into account if the group wanted to work effectively. Weinsten (1995:229) outlined four categories of learning styles;

(a.) Activist - who prefer immediate action,

(b.) Reflector - who prefer to stop and think, and tend to be cautious,

(c.) Theorist - who integrate what they have seen or done into rational schemes,

(d.) Pragmatist - who are keen on trying out ideas, theories, and techniques.

Revans expressed the learning process as L = P + Q, where L was the learning taking place, P was the programmed knowledge which were obtained from books, on tapes or files, while Q was the ability to pose insightful and right questions when things were not certain, and no body knew what to do next. (Inglis,1994: 8).

In this study, the roles of the group members in developing their learning needs were;

(a.) Members should be committed to the group, and attended meetings regularly.

(b.) Members should share the success, mistakes and ideas with each other. They should be honest and open to criticism.

(c.) Members should constantly give feedback on the issues, and informed the set what was helpful and desired by them.

(d.) Involvement by each member was important where every one felt the sense of belonging to the group, and a sense of ownership on the project they were working on.

A learning agreement undertook to achieve the learning objectives with the aim of retaining and transferring the knowledge gained from learning.

3.4.3 Roles of the facilitator

The facilitator provided direction to where the group wanted to be, on how to get things going, and to ensure that the learning objectives were attained. A facilitator was skillful, knowledgeable, and resourceful person in the field of the study.(Inglis.1994: 37). The facilitator who was also the researcher, was a senior administrative officer at the Ministry of Environment and Public Health. He was in-charge of finance and development at the ministry. A person appointed as a facilitator must be proactive because as the group moved further in the learning process, the members gradually begun to take control of their own learning, while the facilitator took a lower profile. In encouraging the group members to learn, the facilitator would ask the members to reflect on what they had learned, or asked both the presenter and the set to reflect on the interactions taking place among them.

3.4.4 Summary on Action Learning of the Action Research Group

Thus far, action learning should have four basic elements to start with which were the persons, the real problems, the action learning group, and the action on the problem in the organization. The main purpose of the action learning group was to develop learning by way of the interactions between the programmed knowledge and questioning insights where changes occured in the behavior of the group members, and learning was based on real life experiences from and with each other. The group member should be prepared to take the risks by being honest and open in the meetings. They should be willing to be challenged by the other members, while at the same time being able to control their emotion, and to react positively to uncertainties when questionings were taking place. In this study, members were empowered or given increased authority over their learning and participation in the group.

In this method, two groups, which were the Action Research Group and the Evaluators, would help the researcher in collecting, analyzing and validating the data.

3.4.5 The Action Research Group

The action research group in this study was a group of people who had intimate knowledge on both towns, and they were keen to assist in the development of the programs for an effective waste management system for both towns.
The members of the group were;

(a.) Mr. Jitien Ritop, age 40 years old, Secretary of Lundu District Council,
(b.) Mr. Segar Kallang, age 40 years old, Health Inspector of Lundu District Council,
(c.) Mr. Anis Abdullah, age 42 years old, Treasurer of Lundu District Council,
(d.) Mr. Goh Loi Ku, age 38 years old, Assistant Valuer of Lundu District Council,
(e.) Mr. Ibrahim Suni, age 51 years old, Councillor at Lundu District Council,
(f.) Mr. Bujang Budin, age 37 years old, the researcher.

The selection of the group members were based on their intimate knowledge on both towns since some of them were local residents of the towns (group members 3,4 and 5), while others like the Council Secretary and the Council Health Inspector were government officers who were directly dealing with solid waste management in the district. The roles of the group were to find solutions to the

problem of solid waste management for both towns. This was done by the following manner;

(a.) Each group member was required to put up suggestions at the group meetings on ways to manage solid waste in a proper manner,

(b.) Group member was encouraged to talk to the public, and get their opinions on possible ways for solid waste management,

(c.) Group member was encouraged to visit the study sites either individually or in group to get first hand information on the sites' situation,

(d.) Group member was encouraged to source relevant literature on solid waste management, or view other practices from any town in Malaysia or outside, to enable them to put up suggestions and ideas,

(e.) Each group member's opinions and suggestions were given the right to be heard in the group's meetings, though decisions on actions to be taken would be decided in consensus by the group.

3.4.6 **The Evaluators**

For the purpose of this study, the following persons were the evaluators, whose roles basically were to evaluate on the findings of the action research group by way of triangulation;

(a.) Mr. Mohamad Zen Masli, Headmaster of Sematan Primary School,

(b.) Mr. Aris Hipni, District Information Officer of Lundu District,

(c.) Mr. Rasdan Hazemi, Assistant District Officer, Lundu District Office.

These evaluators were senior government officials having intimate knowledge on both towns. The first evaluator, 42 years of age, was a local resident of Sematan town and having his home at Lundu town, the second evaluator, 38 years of age, was a senior officer of the Information Services Department who had travelled extensively in the district, and the third evaluator, 29 years of age, was a senior officer in charge of the overall general administration of the district.

The suggestions and findings made by the group members would be checked and cross- checked with each other during the group meetings to see the reliability of the data. These data or findings would then be submitted to the evaluators for validation through the process of triangulation. This was done only if the data or findings need a third party comments. This data, once validated and found to be reliable, would then be agreed by consensus by the action research group as findings of the study, and fit to be implemented.

According to Hunter D, Bailey A and Taylor B,(1996 : 37- 38), the facilitator (researcher) of the action research group must adhere to respect and honour each group member, keep the group safe from interruptions, keep the group on track, ensure that everything said or done by the group is relevant, and work with conflict in the group to attain the objectives. The facilitator (or the researcher) was responsible only to the group with the intention to reach the objectives. This could be achieved by the facilitator through the process of synergy, that was the tapping of the group energy so that the group members were able to accomplish more than they thought possible. In order to attain this, the group should have the purpose of doing the project, the vision to reach in future, the group values and norms while being together must be preserved, the roles of group members must be specific, the project plans must be clear and each member was held accountable, the group must communicate openly and honestly, the group must ensure that learning took place, the contribution

of each member must be recognised, and the group must acknowledge the accomplishment for their successes.(Hunter *et al*, 1996: 45).

The researcher as a facilitator of the group would monitor the energy level of the group. He would sense the group's energy level by listening to the tone of voice, body posture, eye contact, level of activeness towards the task and looking at whether the group members were engaged or disengaged. He would only intervene when it was prudent to interrupt behavior which was impending the progress of the group, or when the group was off the track in the discussion, or the group synergy was undermined, or when the group was posed with physical danger. (Hunter *et al*, 1996: 42).

3.5 Literature review on Action Research

Action research is defined as an approach of fact finding to practical problem solving in a real social situation with a view to improve the quality of action within it. (Burns,1997: 346). It developed after World War II to solve problems in applied settings where a spectrum of activities involving a focus on research, theorizing, learning, and development. Action research describes a process of continuos research and learning in the researcher's long term relationship with a problem.(Cunningham,1993: 3-4). This then encourages the researcher to explore the problem as it evolves in real life problem solving,
and getting legitimization from a real organization.

An Overview

The idea that developed into what is termed as action research was first coined by Kurt Lewin in 1946. He was looking for linkages between practice and knowledge. He placed great emphasis on findings that he called ' the laws which govern social life'. Thus between 1946 to 1952, he developed five fundamentals principles of action research which were;

(a) action research has to focus on real problem in everyday life,
(b) action must be developed to address these problems,
(c) this action evolves a series of cycles comprising planning, action, and evaluation,
(d) the collaborative act of all the members of the group and the researcher is fundamentally important as research subject,
(e) action research is problem solving with the purpose to provide insights to determine social behavior.

McTaggart (1991: 170) developed a new approach in this field by advocating the need for planning, action, observation and reflection in the series of cycles. The need for reflecting was important to enable the researcher and the group to reflect past events. This would help them to modify, amend, add or delete certain activities before the next cycles as new characteristics were developed during the study.

Thus action research explored to discover the learning process taking place in the group. In action research, the body of knowledge developed as all activities were recorded and documented in logs, dairies, reports and notes made by the group.

Therefore the work of Lewin to generate real change in the societies through the cyclical process opened new revolution in the field of research. The original concept developed by Lewin had been expanded, re- interpreted and changed, but

the general idea emerging from fact finding serves as the basis for action.

3.5.1 **The Stages in Action Research**

Burns (1997: 348-351) identified seven stages in developing an action research study. These stages were followed by the action research group in conducting the study;

(a). **Stage 1** involved the identification, evaluation and formulation of the problem that was critical in everyday life. This was what Kemmis and McTaggart (1988:9) called a **thematic concern**, that was a concern of the group and the people on the problem relating to the poor management of solid waste for both towns, thus to work on a project that was feasible to address the problem.

(b). **Stage 2** was the time for fact finding so that a full description could be given of the situation. The group conducted opinion survey via the use of questionnaires, interviews, field observations and official documents related to the issue.

(c). **Stage 3** involved a review of the research literature to find out what could be learned from comparable studies, their objectives, procedures and problems encountered. This was done by the researcher at libraries and through the use of the Internet to outsource information on the subject matter. The information was shared with the group.

(d). **Stage 4** was going through a brainstorming session centered around a problem, generated some hypotheses before proceeding to gather information which was relevant to testing them. In the meetings, group members were allowed to deliberate on issues pertaining to the study based on their own experiences and knowledge.

(e). **Stage 5** was going into action to decide on the selection of research procedures such as the choice of materials, resources, methods, and allocation of tasks.

(f). **Stage 6** was implementing the action. Decisions about the conditions and methods of data collection, the monitoring of tasks and the transmission of feedback to the research group. This stage also involved the classification and analysis of data. To test the findings, the group decided to conduct study project at one of the villages, and to assess the outcome of the project via the use of Evaluation Form.

(g). **Stage 7** involved the interpretation of the data, and the overall evaluation of the project, usually by writing a case study at the end of each cycle. In this situation, each group member was asked to comment on the data and report their findings at each meeting.

Thus, action research study was a step - by- step process constantly monitored over varying periods of time by a variety of mechanism so that feedback could be translated into modifications, directional changes and re-definitions to bring about lasting benefit to the on going process.

3.5.2 **Key Points on Action Research**

Based on the work of Kemmis and McTaggart (1988 : 22- 55) who identified seventeen key points about action research. The group complied with all the seventeen points while proceeding with the research. These points were;

(a). Action research was an approach to improving learning by changing it, and learning from the changes. It was the purpose of the group to work out the best

practices in solid waste management by looking at the weaknesses of the present practices.

(b). It was a participatory effort through which people work towards the betterment of their own practices. The involvement of all the section heads of the Council was the major success of the action research group.

(c). It was developed through a self- reflective spirals of planning, acting, observing, and reflecting, and the spirals continue. At each meeting, group members planned, acted, observed and reflected on the processes taking place with the sole purpose of continuing and improving in the next mini-cycles.

(d). Action research was collaborative as it involved people responsible for action in improving it.

(e). It established self - critical communities of people participating and working together in all phases of the research process. This was attained by conducting a project at one of the villages where the villagers were participating in the planning, monitoring and implementing the project.

(f). It was a systematic learning process where group members acted deliberately, though open to surprises and opportunities.

(g). It involved the group members in theorizing about their practices, actions and consequences in their own lives. Thus acknowledging the need for change.

(h). Action research required the group members to put their practices, ideas and assumptions to the test by gathering compelling evidences which could convince them that their previous practices, ideas and assumptions were wrong. This could be seen at the meetings where members acknowledged the fact that some of the practices done in the past were obsolete and outdated.

(i). It was an open- minded session about what counted as evidence, and in the process the group members were able to analyze their own judgment, reactions, and impressions.

(j). Action research required the group members to keep their own journal or diaries in which they recorded the progress and reflections about two parallel sets of learning which were learning about the practices and learning about the process.

(k). It was a political process because it involved the group in making changes that would effect others.

(l). Action research involved the group in making critical analyses of the situations in which they work.

(m). The action research group started small by working with six people through changes and worked towards extensive changes.

(n). It started with small cycles of planning, acting, observing and reflecting which could help in the defining of issues, ideas, and assumptions.

(o). It started with small group of collaborators at the start, but widens into the community of participating researchers.

(p). Through action research, the group was able to build records of the improvements over activities and practices.

(q). It allowed the group in giving a rational justification of our work to others because we could show how evidence that we had gathered had helped us to create a rationale for what we were doing.

Thus, action research provided a way of thinking systematically about what happened in the society, implementing action where improvements were thought

possible, and monitoring and evaluating the effects of the action with a view to continuing the improvement.

3.5.3 Characteristics of Action Research

There were fifteen characteristics of action research. Twelve of these were general characteristics while three were idiosyncratic characteristics. (Selva, Arnold and Oxenberry, 1996: 12). These twelve characteristics were compared with the approach being used in this study to ensure that this study was indeed an action research study.

Characteristics of Action Research	Characteristics of This Study
1 Problem- Focus	This study was focused on the problem of poor solid waste management practices at Lundu and Sematan towns. The problem was real life situations.
2 Action Oriented	The diagnosis of the problem and the development of the plan were part of a process to implement the plan.
3 Cyclical Process	This study involved cycles of planning, action, observation and reflection on the part of the group.
4 Collaborative Approach	This study was conducted by a team of concerned individuals in a participative and collaborative way.
5 Ethical Basis	The interest of the community, improvement in life of people involved in the study and the needs of the group were given the most priority.
6 Experimental Approach	This study attempted to explore the possibility of developing a sound solid waste management practices for both towns.
7 Scientific Characteristics	The gathering and analysing of data were done both qualitatively and quantitatively by using statistical method.
8 Re-educative	This study contributed in the change of knowledge of the client organisation, the group and the researcher.
9 Emancipatory Characteristic	This study contributed in the

	improvement of the lives of the people involved in the project and may contribute to social reform on solid waste management.
10 Naturalistic Characteristic	The study was set in a natural setting where qualitative descriptions were recorded as case study.
11 Normative Characteristic	In this study, the norms of the group were considered and modified during the research process.
12 Group Dynamics	In this study, the group functioned as an effective team in dealing with the problems that arise during the process.

Thus far, in this study the general characteristics of action research were the fundamental elements in approaching the problem of the client organisation where collaborative effort between the group and the researcher was paramount.

3.5.4 **Application of Action Research**

Action research is applicable to all settings that have a defined thematic concern of a problem. It was first applied to problems in the American industry in the 1940's to address issues in morale, absenteeism and work group relationships.

Further work was done by the Travistock Institute of Human Relation in Britain in the 1940's in a medical setting. The project involved the use of action research by way of providing psychological expertise to select, recruit and treat prisoners of war (Hart and Barn,1995: 20-24).

Barn and Hart (1995:27) noted that in the 1960's, community development projects emerged in Britain to address the problem of poverty as part of the British poverty program by using action research method. This method was used to solve social problems where resources were concentrated on areas of greatest needs, and project groups were to investigate and tackle the causes of social problems. The main objective of this project was to generate new forms of practice which might become accepted social policy.

In the field of education, Kemmis and McTaggart (1988: 5-7) reported that action research was used in curriculum development, professional development, school improvement programs, and system planning and policy development in the United States (in the 1950's) and Britain (in the 1970's). While in Australia, action research has been an important part of the school improvement and educational research scene for more than ten years. The result of the project is improvement in what happens in the classroom and school, and better justification of the educational rationale for what goes on.

In the business scene, studies by action research groups on big companies were done, for example, at the Xerox Corporation in the 1970's to address problems relating to cost reduction, and lower productivity on copy machines market shares in the world. The study showed that through action research, the corporation could save US$ 3.2 million annually by closing unproductive departments, layoff unproductive workers, and buy what they produced from vendors.(White,1991: 21-23).

However, a recent study by using exploratory action research by Selva (1997: 133-134) on the aborigines training and development programs at Port Lincoln, Australia, confirmed the presence of eleven of the twelve characteristics (identified by Peters and Robinson in their study in 1984) of the action research method except the experimental characteristic. This study also showed that action research method could be used to design and implement a management training and development program of the indigenous community leaders.

3.6 **The Research Methodology**

To begin an action research project, there were five steps that need to be taken. These steps as proposed by Cunningham (1993: 70- 73) were;

(a). Entry - Anyone can begin the action research process as long as he/she is interested in examining and become aware of the problem, and the need for change,

(b). Formation of an action research group - Membership to the group would ideally be those in the focal organization or who are in a position to initiate action, and committed to the problem's resolution,

(c). Development of group's goal - In order for the group to function effectively, it must have defined common goals with the need to solve problems,

(d). Training the action research group - this can be done by way of demonstration or practical application in problem solving, and

(e). Research agreement - the group must have access to people who can authorize the research contract, and facilitate research conditions.

Kemmis and McTaggart (1988: 10) described that for action research to take place, the action research group should undertake to;

(a). develop a plan of critical action to improve what was occurring,

(b). act with a view to implement the action,

(c). observe the effects of the action in which it occured,

(d). reflect on these effects as a basis for further planning

Zuber - Skeritt O (1996 : 15-16) developed two steps in action research methods. These steps were;

(a). the formulation of a general plan, and

(b). the collection and gathering of data.

Data gathering were done in the following ways by the group members;

(a) keeping a detailed dairy of description of meetings attended and lessons learned,

(b) collection of official documents related to the study,

(c) observation notes of meetings through checklists, schedules and handouts,

(d) questionnaire surveys using both open and closed formats,

(e) interviews with colleagues or people who were familiar with the situation,

(f) tape or video recording in order to provide an objective record that could be listened, transcribed or analysed,

(g) written descriptions of meetings or interviews which were provided to other people involved, in order for them to validate the records,

(h) triangulation, which was when a situation was investigated using a number of different methods by functioning as a point of comparison with the others.

However, Cunningham (1993: 95- 137) elaborated further by saying that for interviews to be effective in data gathering, the researcher and the group needed to probe into past performance since it could assist in predicting the future. This was

done by conducting the four types of interviews which were (1) behavior description interview, (2) discovery interview, (3) problem solving interview, and (4) the helping interview. In developing questionnaire surveys, there was no standardized instrument in action research since it was a bottom - up process. This emerged from consultation with people in the field, from people involved with the issue, and from those who had interest in learning more about the problem. In order to get better picture of past events surrounding the problem, the use of direct observation and documented evidences were important. By direct observation, it meant that direct contact existed between the action research group and the real setting for an extended period of time where there were opportunity to gain other data presented in the form of personal histories, stories, feelings and experiences. Documented evidences in the form of records, operational information, personal documents (such as dairies, letters, memos and other related documents), and electronic- stored documents were relevant to check on the reliability and validity of the data collected in the field.

Another important aspect in data collection was the use of **participant observation**. Jorgensen (1989 : 12) elaborated that participant observation was appropriate for studies of almost every aspect of human existence. There were seven features to define participant observation, which were (Jorgensen, 1989: 20-21);

(a). a special interest in human interaction as viewed from the perspective of the people who were members of a particular situation.

(b). location in the everyday life situation as a basis of inquiry.

(c). a form of theory stressing interpretation of human existence.

(d). a process of inquiry that was flexible and required constant redefinition of what was problematic.

(e). an in- depth case study approach.

(f). the performance of a participant roles that involved establishing relationships with people in the field, and

(g). direct observation along other methods of gathering information.

3.6.1 How Data were gathered and analysed

Data Gathering Techniques

In the course of the research, data were gathered through the following methods;

(a). In-depth Interview: In this process the researcher asked open-ended questions based on an interview guide, then probed answers. This interview was based on group interviews to explore the group's perspective on the problem and getting supplementary information after a survey had been conducted.

(b). Questionnaires: The researcher conducted questionnaire survey to seek opinion of the general public on the general cleanliness of both towns. The questionnaire was administered to 60 respondents chosen non randomly amongst the people where scavenging services were provided by the Council. It was in closed structured format. The questions were based on four subjects which were (1) the respondents personal data, (2) Solid Waste Management System, (3) Views and Comments of the respondents, and (4) Proposals from the respondents on solid waste management. These subjects were agreed to by the action research group members during the brainstorming session. The distribution of the questionnaire forms were done with the help of the Lundu District Office and Lundu District Council staff. A period of one month was

allocated for the respondents to return the forms through the distributing agencies.

(c). Observation : The researcher personally observed and recorded events relevant to the research problem. This involved systematic observation and participant observation. The subject matters that were observed were workplace behavior settings, service settings and group meetings. Through this experience, the researcher could record events himself given a wide range of information potentially available. All events being observed were recorded in the researcher's diary and field notes. The features that were observed by the researcher were the cultural knowledge of the group, description of activities of the group, the list of features of membership of the group, analysis of patterns of social interaction of group either verbally or non verbal behavior, the insider account of the group, and the development of a theory of a group in understanding what made the group work or otherwise. Inside the group, the researcher looked, listened, took part in the discussion, learned the language used by the group members, made inferences about the group, located informants that could assist the group, developed relationship with the group members, created friends among group members and experienced different ways of life of the group members.

(d) Document Analysis: The researcher had accessed to official documents kept at Lundu District Council office. The documents being analysed were records on organisational strategies, programs, minute of meetings and financial records. The advantages of this analysis were that the researcher had minimal influence on the data and the reliability was relatively easy to assess. The researcher also recorded still photographs of workers doing the job, prepared or copied maps and layout plans of both towns, and diagrams of events that would be done in the subsequent meetings.

Data Analysis Technique

Data collected in the study were analysed by way of both qualitative and quantitative techniques. Qualitative technique involved the use of inductive analysis where data collection and data analysis were done simultaneously. From the outset of the first interview or observation, the researcher reflected on the meaning of what he had heard or seen , therefore developing hypotheses about what it meant and thus seeked to confirm or disconfirm those hypotheses in subsequent observations or interviews. The use of the triangulation method enabled the researcher to achieve convergence where methods of data gathering and analysis complement each other. The researcher also employed the use of content analysis by way of ordering and sorting statements or items to represent a collective view of the problem. (Cunningham, 1993: 160-172). The quantitative method involved the use of statistics to analyze data that needed the summary between variables of statistical significance.

3.6.2 Ethical aspects in Action Research

Like most other research methodologies, action research demanded greater attention to the ethical principles that guided the research work. These activities of research works were the embodiment of the general principles and social norms that existed and being practised in the society or place of research.

The ethical principles for action research in this study were based on the recommendations of Zuber-Skerritt (1996: 16-17);

(a) the relevant persons, committees and authorities were consulted first, and the principles guiding the work were accepted by all,
(b) all participants were allowed to influence the work, and the wishes of those refusing to participate were respected,
(c) the work was open and visible to comments by others,
(d) permission was obtained before making observations or examining documents,
(e) the researcher was responsible for maintaining confidentiality at all time.

3.7 **Summary**

Therefore, action research as used in this study was a concept of looking for solutions and answers to specific real problems in real settings that concern everybody. This concept was known as a thematic concern. (Kemmis and McTaggart,1988: 9-10). In order to look for the solutions and answers, a small group of people including the researcher, worked cohesively together through the four stages which consisted of planning, acting, observing and reflecting with a view to implement the answers to the problems. This process would continue in a series of loops or cycles which were translated into actions where the by - products were the implementation of plans to bring about change and improvement.

In this study, data and findings were validated through the process of triangulation by another party known as the evaluators. Therefore in the research process, learning took place as new ideas were being brought into the group by the action research group members. These ideas were shared and transferred between the group members to continue with the next cycle of re- planning, acting, observing and reflecting.

CHAPTER FOUR
FINDINGS OF THE STUDY

4.0 Introduction

This chapter will discuss the findings of the study based on information gathered by way of questionnaires survey, interviews, observations and official documents available at Lundu District Council office. Data and information were analyzed and validated through the discussions and meetings held by the Action Research Group which consisted of the researcher and five other group members.

The most important aspects that would be discussed were the processes taking place in the group's discussions and meetings. These processes were matters such as group dynamic process on how the group functions as an effective team, whether learning actually took place in the group process, and most important of all was how the group deliberated on issues and problems regarding the subject matter, and finally how this group of people agreed on solutions to the problems in a collaborative and participative way.

4.1 Purpose Of The Study

The study intended to explore the possibility of developing an effective solid waste management practices for Lundu and Sematan towns based on the following research questions;

(a). What were the current level of satisfaction in regard to solid waste management at both towns?

(b). What were the critical factors involved in an effective solid waste management for both towns?

(c). To what extend were Lundu District Council and the general public of both towns aware of the dimensions of solid waste management?

(d). What were the level of readiness of Lundu District Council in contributing to the improvement on solid waste management for both towns?

4.2 Action Research Group's Meetings and The Findings

Preparing the plans

As a researcher, I started the action research journey by making a courtesy call to the Council's top management which consisted of the Secretary, Treasurer and the Health Inspector on the morning at 8.30 am of 7th January 1998. The atmosphere was very friendly and we shared jokes on current issues appearing in the daily newspaper especially those touching on the devaluation of the ringgit and the price hike. After a while I told the Secretary the purpose of my visit and showed him a letter from the Permanent Secretary of the Ministry of Environment allowing me to conduct a research on solid waste management system for Lundu District Council . Without further ado, the Secretary called one of his clerks to invite few more others to listen to the briefing that I had requested earlier. Four people entered the Secretary's room in less that twenty minutes. They were the Assistant Valuer, an Enforcement Officer, the Correspondence Clerk, and a staff of the Rating and Valuation section.

(a) **Briefing on Solid Waste Management**

In conducting the briefing which started at 9.05 am, I had decided to use both English and Sarawak Malay with the purpose that my message got across clearly, they understood them and eventually a cordial kind of interactions developed amongst us. As usual I asked the Secretary that I rather sat than standing while delivering my briefing, and this was agreed by him. I told my audience that I came to their office being not in my capacity as a senior officer of the ministry, but rather as a post- graduate student of UNIMAS doing my research for my thesis. I briefed them on six major items relating to solid waste management which were;

(i.) The Purpose of the research,

(ii.) The sites of the research,

(iii.) The method the research was going to be conducted,

(iv.) The ways data were going to be gathered,

(v.) The duration of the study, and

(vi.) The contribution that this research would have on changing and improving the practices in solid waste management for Lundu and Sematan towns.

The audience sat silently only to be interrupted by phone calls where the Secretary had to answer every now and then. Finally he instructed his clerk to divert the call to the general office. He apologised for the inconveniences and requested me to proceed.

(b) The Purpose of the study

I told the audience that the study was done based on work-based problems and the problems must be real in a real organization. I decided to choose Lundu District Council as venue of the study based on two factors which were;

(i) I had an intimate knowledge of the district, and the problems on solid waste had always been persisting for a long time,

(ii) I had discussed this study with my superiors at the ministry and they agreed that Lundu District Council should be the right place since the council was facing a grave financial problems where solid waste management was one of the contributing factors.

(c) The sites of the study

I told my audience that the sites for the study would be Lundu and Sematan towns. The area to be covered in the study would be within three kilometer radius from the town centre for Lundu town, and for Sematan town the study would cover as far as Kampung Pueh which was twelve kilometer from the town. In other words, the study was done on the areas that were served with scavenging services provided by the council. Within these areas, there were few Malay and Iban villages, few primary schools and two secondary schools. Other than that there were few government offices and quarters, shops, government buildings and public places.

(d) The method for the study

The method of the study would be done by action research, where the participative and collaborative roles of few people having some or no knowledge on solid waste management would form the action research team. In simple term, this study was a teamwork process where the researcher was only a facilitator, and the team would meet regularly to discuss issues and findings. The selection of the

team members would be done latter after a discussion with the Secretary. The decisions made by the team would form the basis for the practices and/or policies to be implemented and adopted by the Council.

(e) The data collection methods

In collecting the necessary data, four approaches were used which were the questionnaires survey, interviews, observation techniques, and official documents from the Council. I told the audience that I might need their help in distributing questionnaires forms or some of the Council staff might be interviewed in the research process. Nevertheless I told them that their assistance would be needed in looking up for official documents related to the study.

(f) The duration of the study

The study would be expected to complete by the end of April 1998. However I told the audience that it did not mean that the issues relating to solid waste management were fully studied. Some day some researches would continue with the study either using the action research method or some other conventional methods. At the end of the day, the Council would benefit most from the studies.

(g) The contribution of the study

After almost one hour conducting the briefing, I told the audience that this was the first study ever conducted on solid waste management in the state involving local authorities. Lundu District Council would benefit most since study projects were conducted and implemented at both towns. If the study proved feasible, then it became a new practice for the council which might be applicable for use by the other Councils in future.

After giving the briefing for slightly more than an hour, I opened the floor for discussions on queries on matters relating to the study. The Secretary did not ask question but merely told his staff that in some Councils solid waste management was privatized. In this process, the Council had to layoff some of their staff. As for Lundu District Council, the Secretary said that privatization might not be implemented soon, but at present the Council were employing contract workers to help in the collection and disposal of solid waste.

(h) The formation of the Action Research Group

After a brief break though no coffee or tea was served because it was a fasting month, the Secretary decided to form the action research group after discussion with myself and his two senior aides. The members of the group consisted of senior council staff and one council counsellor. The members were the Secretary himself, the Treasurer, the Health Inspector, the Assistant Valuer, and the Counsellor to be decided by the Secretary latter.

4.2.2 **The First Action Research Group Meeting**

The first meeting of the group was held on 9th January 1998 at the Secretary's room at 8.30 am. All members were present. The meeting was conducted in both English and Sarawak Malay languages.

The agenda for the meeting was prepared by the researcher which consisted of the following matters;

(a). To identify a sound solid waste management practices from literature which were applicable for both towns,

(b). To explore possibilities in solid waste management system which consisted of (i) waste reduction at source, (ii) reuse, (iii) recycle, (iv) landfill, and (v) the use of incinerator,

(c). To identify the weaknesses in the present solid waste management practices,

(d). To gather information from the public on the effectiveness or ineffectiveness of the present system, and

(e). To identify places where solid wastes were poorly managed.

In the discussion, the Secretary told the group that based on the financial record of 1995 to 1997, the expenditure incurred on solid waste management was higher than the revenue collected from the service.(Appendixes K and L). It was his hope that if a proper system was developed, then fund spent on solid waste could be reduced. The Treasurer added that in 1995 alone a total of RM 125,720.00 was spent on landfills management, repair of trucks, wages and buying of bins, and other things related to solid waste management. (Appendix L) This figure according to him slightly decreased in 1997 where a sum of RM 101, 271.00 was spent. If more new areas were to be included in the service, then he believed the money needed to manage the service would certainly increase. At this point, one of the member, the Health Inspector chipped in by stating that the service would be extended to several new areas in 1998. According to him, eight areas would be provided with the services which were (1) Kampung Dagang, (2) Kampung Sungai Lundu, (3) Jalan Kedaong, (4) Kampung Seketi, (5) Jalan Melintang, (6) Jalan Sekambal, (7) Part of Kampung Sileng Melayu, and (8) Taman Lundu Jaya. The anticipated cost for providing the service to these areas would approximately be RM 14,770.00.(Appendix J). This money would be used for buying bins. The Treasurer responded by posing question to the Secretary by asking where would they get the money from. Looking blankly for answers from the researcher, the Secretary asked the Treasurer to check with the ministry on fund from the ministry. At this juncture, the researcher responded by saying that there would be fund coming from the Federal Ministry on Local Government, provided this fund would not be withdrawn because of the economic turbulence. At this point also, the Assistant Valuer told the group that based on his record on non- payment of rates, a total of RM180,226.94 in arrears as at 1st January 1997. About 24 percent of these arrears came from Kampung Sileng where scavenging services were provided. The Treasurer said it took a long time to recover all the arrears.

The Secretary then requested the researcher to briefly explain solid waste management system being practised in the world. The researcher told the group that based on the literature on solid waste management, the system evolved waste reduction at source, recycling of recyclable wastes, reuse of wastes in other form, and waste disposal facilities such as landfill and incinerator. All group members agreed that it was rather difficult to reduce waste at source as the population of Lundu district increased. However, some group members agreed that waste recycling option might be possible in future provided that the Council had sufficient fund to set up recycling stations, and the amount of waste warranted the setting up of recycle stations. One of the members stressed that only certain wastes could be recycled while in the case of Lundu and Sematan, most of the wastes were thrown to the landfills. The group requested the researcher to look into some aspects of a sound landfill management system as this system was the best suited for the district as at now.

The researcher after looking at some information given by the Health Inspector on the collection system currently being practised, told the group that there were three collection systems basically being implemented in Europe. These systems were known as the Centralised Collection System, the Bring System, and the Collect System. In the first system, a Council or a solid waste management agency provided several big bins placed at accessible points for the householders to bring their garbage for disposal in a centralised collection station, while the second system required that householders to bring their garbage to a collection point designated by the Council, and the third system was basically what Lundu District Council was doing by collecting the garbage door- to- door. The group agreed that the first system could be implemented at villages accessible by roads. One member said that the present system of collecting door - to door was not only time consuming but also costly.

While the group was busy discussing and deliberating on the issues, the researcher noted that the Health Inspector was busy taking down notes on points discussed at the meeting. The Secretary requested him (Health Inspector) to brief on the activities his section were doing on solid waste management. According to him a sum of RM35,911.00 was spent on buying bins for Lundu while RM 13,852.00 for Sematan.(Appendices E and F). The collection schedule was from Monday until Sunday, where garbage from the town centre were collected daily while at other areas, garbage collection was done alternately three times a week. At present the number of premises that were provided with the scavenging services were 557 units, where there were 373 units at Lundu town, and 184 units at Sematan town. (Appendix G and H). There were two units of solid waste collection team with six scavengers. One unit was at Lundu town and the other at Sematan town. At this point the researcher told the group that the proper term used for workers collecting the garbage was " packer or loader" rather than scavenger. He explained that the term scavengers rightly referred to people who took unwanted things from the landfills. All members laughed as simple term could cause bad impression on certain profession.

The Health Inspector thanked the researcher for introducing him with the new term on solid waste management. One member requested that a survey should be done on the public to assess the effectiveness of the present system. This was agreed by the group, and the researcher told them that a questionnaires survey would be conducted soon. The researcher with the consent of the group pointed out the points discussed during the meeting which were;

(a) The views of the public must be obtained to assess the effectiveness of the present system by way of questionnaires survey,

(b) The group members were to reflect on the system that would be implemented in future, and some readings must be done to get more information,

(c) The researcher would look into the methods in landfill management practices applicable to the district,

(d) The Health Inspector would look into solid waste practices being implemented currently. The Treasurer would look into the financial aspects if more areas were to be covered in future, and the Assistant Valuer was requested to work on the detail of arrears from places being provided with scavenging services, and

(e) The Secretary himself would deal with the policies governing solid waste management issued by the ministry.

The meeting adjourned at 12.30 noon, and the researcher thanked all members for giving their cooperation and sharing their knowledge on the subject matter. The date for the next group meeting would be discussed by the researcher with the Secretary, and members would be informed by the Secretary. The researcher told the members to go home, relax and incubate with the expectation that new ideas would come by as they illuminated later on during the second meeting.

Outcomes of the meeting.

In action research, the cyclical process of planning, observing, acting, reflecting and evaluating form a mini cycle. All these processes took place in the first meeting when all group members deliberated in sharing ideas and knowledge to develop a general plan with focus on the problem(s) to be addressed. The researcher observed the gestures made by the group members on how they interacted with other members, on how they reacted to questions that required real- time response, how they interrupted when discussions were going on just for the purpose of putting their ideas, and on how they argued over matters that were more close to their hearts. The group members acted quickly in response to questions being posed to them if the answers to the questions were within their faculty of knowledge, while they would show a gesture of withdrawal if the answers to the questions needed some research or data findings. A number of times group members became quite in the course of discussion if the subject matters being discussed were new to them. They reflected by remembering and thinking about their experiences in the past. These experiences were then related to the subject matters under discussion. This helped in explaining the subject matters more easily to group members so that they could prepare for the subsequent planning in a succession of cycles. (Kemmis and McTaggart,1988: 9).

It was observed that group members whilst in the process of discussion were more focused to the problems affecting solid waste practices. Their understanding of the problems helped them to contribute ideas in the discussion. The collaborative teamwork approach worked as members were committed to the tasks given to them. The action- oriented method of approaching the problems gave the members opportunity to explore more possibilities in finding solutions to the problems. This was evidenced during the discussion when members spoke freely on what they perceived as the right thing to do and the Council must try to implement. The setting of the discussion was done in an informal way where members felt relaxed, and they behaved in a natural way. The researcher acted as a facilitator to ensure that the group was on the right track and only confining their discussion on the subject matters. The process of learning took place as members gathered new information and knowledge on solid waste management practices. To some members their knowledge on solid waste management were confined only to the process that they saw in their everyday life. By giving more information and techniques on the development of solid waste management they could learn new things, and thus the re-educative process in learning occurred. However the norms of the group were respected at all times, elders were treated with respect and their ideas were discussed in fair term.

According to Burns (1997: 348-351), the action research group developed seven stages in the course of their meeting or discussion.

Stage One- the group developed a general plan to work out issues relating to the problems.

Stage Two- the group collaboratively discuss on methods on how data were going to be collected and who were responsible for collecting data.
Stage Three- the discussion of the group must relate to certain literature on the subject matters as this would help in getting new input/ideas which would increase the knowledge of the group members.
Stage Four - Once the group was in session, brainstorming took place as members begun to share ideas with other members or refuted ideas from other members.
Stage Five - the group at the end of the discussion might decide on the procedures to be adopted in conducting the research. This would help the group in planning future meetings, and tackling uncertainties.
Stage Six - As more information were needed to answer questions pertaining to a particular problem, the data collection methods must be devised by the group to facilitate discussion.
Stage Seven - the group would decide on the data relevant for discussion or the study, and interpreted them according to the requirements of the study and the group. These data were evaluated by way of clarification by group members or outsourcing for expert opinion through the process of triangulation.

4.2.3 The Second Action Research Group Meeting

The second meeting of the group was held on the 21st February 1998 at the office of the Treasurer. The time was at 9.30 am and only five members were present. One member could not come because he had to attend to an official function where his presence was important. The researcher reminded the group that it was equally important for all members to come unless enough notice was given so that the meeting could be fixed to another date. As usual both English and Sarawak Malay were used during the discussion. From the researcher's observation, the members were happy due to the fact that they had been away from the workplace for quite sometimes after celebrating the double festivals of *Hari Raya Aidilfitri* and Chinese New Year.

To start the meeting going, the researcher briefed the group on the agenda of the meeting. Though the meeting was conducted in an informal manner, the agenda would help the group to focus the discussion only on the subject matters. The agenda for the second meeting were as follows;

(a) To discuss findings from the Questionnaires survey,
(b) To discuss findings on the interviews,
(c) To discuss findings obtained from the researcher's field observations on the landfill management and solid waste management at both towns.

Findings from Questionnaires survey (Appendix B)

The researcher briefed the group the result of the survey which was conducted for almost a month. The survey was administered to 60 respondents where 30 people were selected from Lundu while another 30 were from Sematan. The selection was made non - randomly. The survey forms were given to the respondents with the help of the Assistant District Officer. The respondents consisted of village heads, community leaders, government officers, members of the Village Development Committees, and some villagers. The respondents were people who were provided with the scavenging services by the Council. The questions of the questionnaires were both opened and closed structured, and written in *Bahasa Malaysia*.

The outcome of the survey was 65.40 percent of the respondents indicated that both towns were not clean as there are not enough bins. This was due to the fact that rubbish, garbage and other solid waste were discarded indiscriminately at nearby villages, bazaars and the nearby rivers. About 69.20 percent of the respondents indicated that the scavenging services of the Council were not satisfactory done. The reasons were because solid waste collection schedules and time were bad. A total of 54 percent of the respondents agreed that the bus terminals, markets, backyards of shops, shops five-foot ways, town drains, and the town squares were dirty. Another 71 percent of the respondents indicated that the most common types of wastes were domestic waste, municipal waste, and commercial waste. From the survey, 77 percent of the respondents indicated that the Council should implement the centralised collect- systems where larger bins were to be used and placed at strategic locations at roadsides or road kerbs of town zones, nearby villages and schools. Nevertheless all the respondents agreed that the Council should continue with the present solid waste collection system. On waste collection schedule, 69 percent of the respondents indicated that solid waste should be collected daily at town zones and three times a week at nearby villages, and 61 percent of them indicated that the collection time should be at 5.00 am in the morning for Lundu town and 7.00 am in the morning for Sematan town. On landfill management, 77 percent of them indicated that there should be no open burning, the landfill must be kept close, it must be sited far away from human dwellings, it must be free from flies and animals, it must not emit bad odor, and did not pose health hazard to people. However 62 percent of the respondents indicated that the Council should have avenues for solid waste complaint in the form of a telephone hotline, a solid waste management committee, and a solid waste mobile unit. The researcher reported that 92 percent of the respondents preferred the High Density Polyethylene (HDPE) type of bins.

Findings on the Interview (Appendix C)

The researcher reported that the interview was conducted on 17th February 1998 at 2.00 pm at the Public Health section office. The interview was administered on the packers of Lundu and Sematan, and four of them turned up. The interview questions was opened- structured and contained 36 questions. The findings from the interview were;

(a) the packers collected between 200 to 288 bins of solid waste of various sizes everyday at Lundu town and less than 100 bins at Sematan town daily.

(b) the content of most bins were plastic wrappers, plastic bottles, paper, domestic waste, and some bulky waste.

(c) a lot of the garbage were found at the bazaar, Federal and State quarters, the road junctions of Kampung Sileng and Kampung Seketi of Lundu town. While in Sematan town, most garbage were found at Kampung Pueh, Pueh Youth Camp and the bazaar.(Appendices M and N).

(d) the distance in location between one bin to another bin was in the region of 12 feet to more than 100 feet apart.

(e) the packers received a lot of complaints from the public on waste collection especially when wastes were not collected on time.

(f) most householders did not throw or place the garbage properly into the bins.

(g) the amount of waste collected each day was approximately four tons for Lundu town and three tons for Sematan town.

Amongst others the packers told the researcher that collecting garbage was difficult during rainy days. They also noted that the placement of individual bins at residential areas were not proper. Most of the householders placed their bins at the front of their houses, while some placed them at the back of their houses. They requested that bins should be placed at the front of the houses or along roadsides for easy movement of the bins, and garbage must be kept in plastic bags before being placed into the bins. They requested the Council to issue notice to the householders on the collection schedule and time. They also told the researcher that since collecting solid waste was not hygienic, the Council should send them for medical check- up once a month.

Site observation on landfills (Appendix I)

The researcher reported that the visits he made to the landfill at Kampung Stunggang was on the 16th February 1998, while the Kampung Sebat landfill was inspected on the 18th of February 1998. From his observations on site;

(a) the landfill was not fenced, and this enabled dogs to scatter the garbage all over the place.

(b) most of the wastes disposed were plastic bags and wrappers, plastic bottles, cans, paper and wood boxes, old tyres, and domestic waste.

(c) the wastes were piled into many small heaps at all over the place and no earth filling was done.

(d) the landfill was smelly.

(e) flies were seen at heaps of moist wastes.

(f) the road leading to the landfill was gravel with many pot holes.

On the whole the researcher observed that both landfills were not properly managed. The location of the Kampung Stunggang landfill at the Lundu- Bau road was not ideal as a waste disposal facility. The nearest dwelling to it was Kampung Stunggang which was approximately one kilometer away, and nearby was a Muslim cemetery. The Kampung Sebat landfill was very close to Kampung Sebat and Kampung Pueh which was less than one kilometer from both villages.

Site Observations of Lundu and Sematan town centres.

On the site- observations made by the researcher at both towns, he told the group that at Lundu town which he visited on the 25th December 1997 and 15th February until 20th February 1998, the following places were found dirty;

(a) the bus terminal- rubbish were thrown indiscriminately.

(b) the wet and dry markets- rubbish and some garbage from fish and vegetable stalls were thrown into the drains.

(c) the drains of the shops were cloaked with rubbish, and

(d) the backyards of the shops were full of rubbish.

At Sematan town which he visited on the 25th December 1997 and 18th February 1998, the following places were found dirty;

(a) the bus terminal- rubbish were thrown indiscriminately.

(b) the temporary stalls built by the Council at the front of the bus terminal were dusty and rubbish could be seen everywhere,

(c) the drains of the shops were cloaked with rubbish,

(d) the wet market was dirty due to unwanted fish parts and vegetables were thrown into the drains, and

(e) the backyards of the shops were dirty due to some garbage were thrown into the drains.

The members of the group were given copies of the reports to enable them to deliberate on the issues. Most members agreed that both towns were not very clean though effort had been made over the years to keep both towns clean. One member pointed out that where Council did not provide the scavenging services to the villages, the householders usually discarded their garbage to the rivers. This happened at Kampung Stunggang, Kampung Sileng, Kampung Sungai Lundu, and even at villages in Sematan. The researcher said that the amount of wastes at the bazaars, nearby villages and along roadsides leading to the villages were high due to the fact that the bins were not sufficient or the sizes of the bins could not accommodate the volume of the wastes. He noted that all of the bins being used at the bazaar were the standing-bin type of 80 litres in capacity. The Council provided few bulk-bins of 1100 litres and 660 litres at road junctions at the nearby villages. He told the group that the amount of solid waste collected daily was in the range of 3 to 4 tons at 13 locations for Lundu, while for Sematan town, the amount of waste collected daily was in the range of 1.5 to 3 tons at 11 locations. He pointed out that almost 80 percent of these waste were domestic waste (which consisted of food waste, paper, plastic, textiles, bottles and tin cans) while the rest were commercial waste and office refuse. From his observation and personally driving to the collection points, the farthest collection point for Lundu was about 4 kilometers from town, while for Sematan, the farthest collection point was about 12.5 kilometers from town. He pointed out that the travelling time was much longer for Sematan, and he anticipated that the scavenging team from Sematan travelled not less than 20 kilometers a day.

The Secretary pointed out that the Council could not provide the two-wheeled bin type for the bazaars because they were very costly unless the shop owners were willing to purchase themselves. Efforts were being made to increase the number of bulk-bins at nearby villages. He also pointed out that cleanliness campaigns had been done over the years but public participation especially from the bazaars were poor. He cited examples when a member of the public told him that the Council was responsible in waste management and in keeping the towns clean, and the members of the public need only to pay for the yearly rates. Another member supported these statements by citing cases where members of the public merely placed bulky wastes such as old furniture, unused refrigerators and so on at the roadsides, and when the packers refused to collect these items, the member of the public complained to the Council. The researcher understood that situation such as this may occur when members of the public had little information on solid waste management. He proposed to the group that the Council should adopt the practices of Kuching North City Council where bulky wastes and garden wastes were collected only when the members of the public had requested the Council to collect them. This kind of service was not free since the householders need to pay certain fee to the Council. He said Lundu District Council should initiate this move and inform the public. A member of the group proposed that centralised collection system based on zones would be ideal for the nearby villagers.

On the issue pertaining to solid waste collection schedule, a member of the group said that the existing schedule involving daily collection for the bazaars and alternate three times collection for other areas, was good enough since the Council

had only one team each of packers to manage an area within more than three kilometer radius of both towns. The researcher told the group that the existing system being used by the Council in waste collection, transfer and transport was also being practised by other district councils and municipalities in the state. The most important issue that the group need to address pertaining to solid waste collection was the timing, and on which day the packers should collect waste from each locality. Priority should be given to localities that generated the most wastes. A group member said that the timing and the collection- day for solid waste collection was fine but the members of the public did not understand when the collection would be done at their locality. A member then interrupted by asking the group to inform the public on the time and the day solid waste should be collected based on the localities and the volume of wastes. At this juncture, a member of the group went out of the meeting. The meeting stopped for almost twenty minutes to enable two group members to call him back.

The meeting continued when three members entered the room. The environment was not as tense as the earlier session. Every member was more relaxed. The researcher switched the topic of discussion on landfill management. The Secretary told the group that the siting of the landfill was not made by the Council. It was decided upon by the State Siting Board. However he informed the group that Environmental Impact Assessment (EIA) study was done for the landfill in Sematan in 1994 while the landfill in Lundu was opened much earlier and EIA study was not done. He acknowledged the fact that the roads leading to the landfills were not sealed, and no fences were put up. He asked one of the group members to check if fund could be made available this year (1998) for the tar sealing and fencing of the landfills. A member added by informing the meeting that the management of the landfills was done by the Council, however the constraint that they were facing was not having enough fund to do the tar sealing of the road and fencing of the landfill. On top of that they had difficulty in getting hill earth for earth filling purposes. However he supported the suggestion made by the Secretary that on availability of fund the landfills would be fenced and the road would be sealed. He further informed the meeting that pesticide was sprayed very often to kill the flies, and this method was found to be very effective.

The researcher requested one of the members to explain to the meeting the types of bins being used and the number of bins that had been distributed to the various locations for both towns. The member told the group that there were five types of bins being used at present which were (1) bulk mobile garbage bin - 1100 litres, (2) bulk mobile garbage bin - 660 litres, (3) two wheeled bins - 240 litres, (4) two wheeled bin - 120 litres, and (5) randy litter bin - 120 litres. The bins were of OTTO and SHAEFER brand names. These bins were distributed to only 32 locations in the district. There were a total of 40 locations or collection points in the district. (Appendix D)

Matters Agreed at the Meeting

The researcher told the group that it would be appropriate to decide and to agree on the subject matters that require immediate action from the group. There were no objections from the group members. One member reminded the group that implementation of the activities could only be possible if the Council could get fund from the government. The Secretary however suggested that what were agreed in principle in the meeting would form the course of action that the Council would take between now and the future. Therefore the following matters were

agreed in principle to be implemented subject to modification, in stages by the Council.

(a) General Cleanliness of both towns

(i) The group agreed that the Council should take necessary steps to improve the general cleanliness of both towns,

(ii) The group agreed that the Council should extend scavenging services to the nearby villages,

(iii) The group agreed that more bins should be placed at both towns,

(iv) The group agreed that the collection time and day for solid waste collection, transfer and transport should be re-scheduled,

(v) The group agreed that contract workers should be employed to clean the towns especially the bus terminal and the market, while Council workers would clean the other parts of the towns,

(vi) The group agreed that billboards should be put up at both towns and the surrounding areas informing the general public on keeping the town clean.

(vii) The group agreed that the Council should implement a solid waste complaint avenue, and

(viii) The group agreed to the suggestion of one of its members to implement a zoning system at nearby villages for solid waste collection, transfer and transport. This project would be carried out at Kampung Stunggang Melayu, Lundu immediately after meeting the Village Development Committee , and one village in Sematan would be done at a latter stage.

(b) **Solid Waste Zoning System**

The idea behind the formulation of this system was the brainchild of one of the group members. This idea was accepted by the group and to be made into the group's projects which would be carried out at Kampung Stunggang Melayu, Lundu, and another village in Sematan. The villages chosen to carry out this project must be within the town limit where scavenging services were provided by the Council and these villages must be accessible by road so as to enable the compactor - truck to pass. The modus operandi of the system was simple where the following matters would be set up:

(i) A Solid Waste Village Committee was to be set up to manage, monitor and administer the system,

(ii) An Assistant Health Inspector from the Council would sit in the committee to give guidance and advice,

(iii) A village zone would consist of a few houses (preferably not less than 20 houses),

(iv) Each village zone would appoint a leader who would sit in the Solid Waste Village Committee, and

(v) The Zone Leader would be responsible for solid waste management of his/her zone,

(vi) The Council would provide Bulk Mobile Garbage Bins (1100 litres) and the collection, transfer and transport services of the garbage.

In discussing this idea, the group established three objectives of the zoning system. These objectives were;

(i). To encourage public participation on solid waste management at their own zone.

(ii). To create awareness in the mind of the members of the public that solid waste management was the responsibility of all members of the society.

(iii). To create a healthy environment where solid wastes were discarded and managed in a proper manner.

The group decided that further discussion on this idea was pertinent, and an evaluation method must be developed to assess the feasibility of the system.

(c) **Landfill Management**

(i) The group agreed that both landfills at Lundu and Sematan would be fenced, and the roads to be sealed.

(ii) The group agreed that the Council should have more mitigating measures on leachate discharge, gas production, odour emission, and vector habitats control, and

(iii) The group agreed that the Council should have a place to stockpile hill earth for land filling purpose.

The Secretary told the meeting that since the request made by the packers were administrative in nature, the Council would decide on it latter. However he agreed that the packers should go for medical check- up every six months, and the Health Inspector would deal with it.

The meeting ended at 12.00 noon. The researcher thanked the group members for the invaluable ideas and opinions. He requested them to incubate, illuminate and accommodate for the coming meetings.

The Secretary with the consent of all members agreed that the next meeting would discuss further on the issues raised and agreed during the meeting.

(d) **Outcomes of the meeting**

In the second meeting, group members were allowed to put up ideas in a brainstorming session based on the findings of the Questionnaires survey, the interview survey and the site visit reports. In this situation, group members were either opposing or agreeing with the findings. Members who agreed with the findings acknowledged weaknesses in the existing solid waste management practices. Other members who opposed the findings felt that the general public failed to understand the roles and functions of the Council in solid waste management. Thus conflicting ideas developed as the group deliberated on the subject matters. In group facilitation, according to Hunter *et al* (1996: 36),

> *Group facilitation is the art of guiding the group process towards the agreed objectives. A facilitator guides the process and does not get involved in content. A facilitator intervenes to protect the group process and keep the group on track to fulfil its task.*

This was what the researcher did in keeping the group intact and on the right track. The main idea was to create a kind of group synergy where each group member was given room to speak up his mind.

Hunter *et al* (1996: 38) further stated that;

Disagreement is the natural result of different personalities, different views and opinions. If a group is to develop to maturity, it will need to work with conflict, rather than avoid it.

The most important lesson that could be learned from the second meeting was to respect and honor the opinions and views of each group member. In dealing with conflicting ideas and opinions, the group resorted to cooperate or work together to find the best solutions to the problems or issues being raised. In this manner the group compromised on accepting the solutions that partly satisfied both parties.

Weaver and Farrell (1997: 91) stated that;

Compromising is intermediate in both assertiveness and cooperativeness. The objective here is to find some quick, mutually acceptable solution...It falls on a middle ground between Competing and Accomodating.

4.2.3 **The Third Action Research Group Meeting**

The third meeting was held on the 16th March 1998 at 2.00 am at the Conference Room of Lundu District Council office. All the members of the action research group were present. This meeting was also attended by members of the Village Development Committee of Kampung Stunggang Melayu. They were Haji Uri Markom, Mr. Sidi Matlias, Mr. Madeli Sudin, Mr. Nusi Ismail, Mr. Abdul Talip Baee, and Mr. Putit Haji Matsa. They were invited to discuss plan to establish solid waste collection system on zoning basis which would be implemented at their village as a project of the group.

The meeting was chaired by the Council Secretary. Local Sarawak Malay was used as the medium of the meeting. In his welcoming address, he acknowledged that the request made by the people of Kampung Stunggang Melayu for the scavenging service was actually done in the past two years. According to him, due to financial constraint, the request was not fulfilled, and the meeting on that day was aimed at fulfilling the request made two years ago. He explained that solid waste were any waste that were unwanted or discarded by people. The project that would be implemented at Kampung Stunggang Melayu would only be confined to the collection of domestic waste. He told the members of the Kampung Stunggang Melayu Village Development Committee that the sole purpose of the meeting was to encourage public participation in solid waste management and at the same time to create public awareness on keeping their place clean. He then requested one of the group members, the Health Inspector to brief on the solid waste management programs being done by the Council at the moment.

The Health Inspector speaking in local Sarawak Malay told the meeting that the solid waste program did not cover Kampung Stunggang Melayu due to the fact that the Council did not have enough fund for that purpose. According to him, under the new program, Kampung Stunggang Melayu would be included in the 1998 Solid Waste Management schedule. In solid waste collection for their village, he stressed that only domestic waste would be collected, and these wastes should be first placed in plastic bags before being put in the bins. The Council would provide the bins and the collection schedule was proposed at three times a week which would be Monday, Wednesday and Friday. The scavenging unit would collect the garbage at 5.00 am in the morning. However, he informed the Village Development Committee to remove

coloured-bulbs posts at the roadsides of their village as this could hinder the movement of the compactor-truck.

At this point, the researcher told the meeting that the collection schedule as proposed by the Health Inspector covered not only the Kampung Stunggang Melayu area, but a few other areas as well. He informed the meeting that it would be wise to collect the garbage at Kampung Stunggang Melayu as the last stopping point for the scavenging unit as the landfill was only less than a kilometer from that village. He further stressed that as at present the volume of wastes being discarded daily were approximately five ton. Thus with the inclusion of this new area, the waste volume would increase for Monday, Wednesday and Friday given the fact that Kampung Stunggang Melayu was the second largest Malay village in the district with not less than 180 houses. This fact was agreed to by one of the Village Development Committee member. The Secretary thanked the Health Inspector for the briefing on the solid waste program currently undertaken by his section. The Secretary then requested the Treasurer to briefly explain the mode of payment for the project at Kampung Stunggang Melayu. Before giving his briefing on the payment method, the Treasurer passed around his briefing notes to the members of the meeting. In his briefing, the Treasurer said that based on the record which he obtained from the Rating and Valuation section, there were 179 houses at Kampung Stunggang Melayu. This contributed to RM 23,973.00 in the annual rateable value for the Council. According to him, the Council classified this village as sub-urban though in reality the village was less than a kilometer from the bazaar or town center. Thus based on the number of houses at the village, the Council could collect RM179.00 a month from the scavenging service if each household was charged a minimum rate of RM 1.00 a month.

The responsibility of collecting the payment would be done by the Zone Leader who would latter pay to the Council. If a particular zone failed to pay the monthly payment, then garbage from that particular zone would not be collected by the Council. At this point the Assistant Valuer interrupted by saying that the payment for the scavenging service would normally be included under the annual assessment rate of property based on the 4.5 percent rate. The Secretary pointed out that as this was a pilot project on scavenging service where the public was responsible for managing their own garbage, the mode of payment would not be included in the annual assessment rate. The discussion stopped for a while when light refreshment was served. The Secretary invited all the members of the meeting to have a break while at the same time allowed for discussion to continue. A member of the Village Development Committee told the meeting that they were 182 houses at Kampung Stunggang Melayu based on count made by him. These houses included residential dwellings, village shops and motor workshops. He also informed the meeting that they were two parts of the village. One part was on the right bank of the Batang Kayan river and the other part was at the left bank of the river. He wanted to know whether the scavenging service covered both parts of the village.

The Health Inspector said that only the part at the right bank of the river would be serviced while the other part would not be done immediately. This was due to the difficulty for the compactor truck in crossing the river as the ferry service was opened for use by the public and the compactor truck had to queue inorder to cross the river. The waiting time was long as there were lot of vehicles using the ferry. A member of the Village Development Committee

was not happy with this statement and insisted that the service should be extended to the people living at the left bank of the river. To calm the situation, the Secretary told him that the service would be done at a latter stage as the Council would need to study the situation that involved the use of the ferry service. Feeling upset with this remark, he told the meeting that it was not necessary for some of them to attend the meeting as they had nothing to report to the people at their zone.

The researcher told the meeting that based on his reading from literature on solid waste management practiced at remote areas in Ecuador, a system developed by the local authority and practiced by the people living in the slums (where there were no roads) was the use of a tricycle designed for solid waste transportation. The tricycle would collect the garbage from the houses in the slums and transported them to collection stations where the compactor truck would latter on collect the garbage. If this practice could be used in collecting garbage for households at the left bank of the river, then the question of who would volunteer to transport these garbage by using tricycles. There was no response from the members of the Village Development Committee on this subject. The Secretary responded by saying that the idea was good but not practical at this point of time.

Therefore with the constraint due to the separation of the village by the river, the meeting agreed that only the houses at the right bank of the river would be provided with the scavenging service. The members of the Village Development Committee agreed that the rate charged on each household regardless whether the premise was for human dwellings, shops, store or workshops, would be RM 1.00 per household per month. However the Council was requested to count the number of houses at the right bank of the river to determine the exact number of houses for the purpose of payment. The researcher pointed out that based on the figure given by the Village Development Committee, there were six zones and the number of houses were between 13 to 42 houses at each zone. Thus where ever possible, he proposed that each zone should contain not less than 20 houses. The Secretary requested the Village Development Committee to consider this proposal and work out among themselves in assigning houses to the zones. Before the meeting was adjourned, the researcher requested that the outcomes of the meeting be read to the members. The Secretary agreed, and having taken the notes from the Health Inspector who was assigned to take minutes of the meeting, read the decisions of the meeting.

(a) **Outcomes of the Meeting**

The outcomes of the meeting were as follows;

(i). The scavenging service based on the zoning system would be implemented on the 1st of April 1998.

(ii). There would be six zones headed by a Zone Leader who would be appointed by the zone.

(iii). The fee to be charged on each household would be RM 1.00 per month and the Zone Leader was responsible for collecting the fee and paying them to the Council.

(iv). The Zones would decide on where the bins were to be placed at their zones and the locations must be paved with cement concrete.

(v). Houses owned or constructed under the Poverty Eradication Program of the District Office would not be charged any fee.

(vi). Educational, religious and charitable institutions would not be charged any fee.

(vii). The Council would provide bulk-bins to each zone and the collection schedule would tentatively be on Monday, Wednesday and Friday.

(viii). Any problems arising from the deployment of this system or complaints made by the householders must be conveyed by the Zone Leader to the Village Development Committee who would then discuss the issues with the Council.

The Secretary wrapped up the meeting by thanking all the Village Development Committee members for making their time for the meeting and requested a close cooperation from them by making this project a success project. He also thanked the action research group members for contributing ideas and proposals in the meeting.

The meeting adjourned at 4.15 in the evening as the office working hour was over.

(b) **Lessons learned from the Meeting**

Though the meeting was conducted in a formal manner where the Chairman addressed the meeting and agenda was followed closely but the brainstorming session was allowed to flow continually. This allowed members from both parties to express their views openly on how best the zoning system should be developed.

Before coming to the meeting, the action research group members had studied the situations closely where possible alternatives were developed in case there were disagreements from the members of the other party. The researcher had planned on how the zoning system would work based on the centralised collection system that he had read from the literature on solid waste management. Likewise the Treasurer had done his study on the payment system after looking at the number of houses that were to be provided with the service, and the arrears on the annual assessment rate that had not been paid for the past few years. This annual assessment rate was inclusive of the 4.5 percent charge on scavenging service. Thus he came up with the idea of a monthly payment rather than having the payment to be included in the annual assessment rate. The Health Inspector was more concern with the nature of waste generating from households and the way these wastes were to be discarded. Thereby he proposed that the garbage must be put into plastic bags before putting them into the bins. This would enable easy handling of the bins without the garbage being thrown onto the roads or pavement. However, the Secretary was more keen in providing the service since it had bothered him for the past two years when the request was turned down due to financial difficulties. The Councillor being a member of the action research group was more persistent in having the service extended to the village because he was the representative of the village in the Council. He had voiced the problem for the past two years due to his concern on garbage being thrown into the river. He had done a good job by informing the Village Development Committee members to attend the meeting and proposing to the action research group for the project to be done at Kampung Stunggang Melayu. On the other hand, the Assistant Valuer, though putting more concern on the arrears of rates, did

prepare some estimation on the possible amount to be paid on scavenging service if it was extended to the village.

However from the observation made by the researcher, none of the action research group members were aware of the constraint in managing solid waste collection and transfer when it involved a village being cut by a river that separated it into two parts. The ferry service was seen as a hindrance to allow easy movement of the compactor truck from the right to the left bank of the river. The whole idea would be feasible if a bridge was constructed across the river. This situation was easily seen in the eyes of the members of the Village Development Committee who stayed at the left bank of the river. The frustration was portrayed by the way they responded to the statement made by the Health Inspector when they said that there were of no use for them to attend the meeting as they had nothing to report to their zone.

The idea of using tricycles for transporting garbage from the left bank to the right bank of the river was a way out to solve the problem. The tricycles would not occupy big space in the ferry as the volume of wastes to be carried were small. However, there was no response from the members of the Village Development Committee living at the left bank of the river. The presumption of the researcher was that the idea was something that caught them by surprise because they were expecting the Council to send the compactor truck right to the foreground of their houses regardless of the problem involving the ferry. By saying that the idea was good but not practical, the Secretary was implying that the Council would not use their employees to paddle the tricycles to collect the garbage at the left bank of the river. This would cost more money and time consuming. It was his proposal that a study would be carried out to assess the possibility of collecting garbage at the left bank of the river in the near future. Therefore it was safely assumed that the people living at the left bank of the river would continue to discard their garbage into the river. Given the fact that the project would be implemented in early April 1998, the action research group would evaluate the outcomes of the project after six months the project was off the ground.

On the whole, the researcher observed that group dynamics were on play as the two parties exchanged ideas and proposals to the plans being put up earlier. The setting was very natural as members of both group begun to know each other and the discussion was rather informal as the flow of the meeting was preceding well. Both parties learned the basic principle that in order to get the public to participate and the Council to initiate the project, teamwork involving people from both sides of the group was important. The first round of the meeting was fruitful as there were commitments from both parties to have the project implemented immediately.

4.2.4 **Fourth Action Research Meeting**

The fourth action research group meeting, which was the final meeting was held on the 20th April 1998 at 10.00 am at the office of Lundu District Council. All group members were present. The researcher prepared the agenda for the meeting which consisted of the following matters;

(a). Solid waste proposal for 1998,

(b). Solid waste collection schedule,

(c). Methods for solid waste management,

(d). Proposed ways for cleaning both towns,

(e). Methods for landfill management practices,

(f). Revenue from solid waste management, and

(g). Expenditure on solid waste management.

As usual the meeting was conducted in both English and Sarawak local Malay. It was more than a month since the third meeting of the group. The fourth meeting was supposed to be held on the 18th April 1998, but due to unforeseen circumstances, the Council Secretary called the researcher by telephone that the final meeting would be postponed because a relative of one of the members had passed away. As a matter of respect, the researcher agreed that the meeting was to be held two days latter.

On the morning of the 20th April, all group members were present at the Council's office at 9.30 am. While waiting for the agenda to be printed, the Secretary invited the group members to have a tea break at a nearby coffee-shop.

At 10.00 am, the group met at the office of the Secretary where the researcher informed that for the past one month he was quite busy attending to some important matters at his office and UNIMAS. However, he told the meeting that since it was more than a month they all had not met, he hoped that what had transpired during the previous meetings were still fresh in their minds. He hoped that all group members could contribute more in the final meeting where any changes that had been discussed earlier need to be clarified before they agreed on the course of action to be taken on matters pertaining to solid waste management practices. All members were given the printed copy of the agenda.

The Secretary told the researcher that if possible he would like the meeting to end before 12.00 am as he had to attend to other important Council matters. All members agreed.

(a) Solid Waste Proposal for 1998

The researcher pointed out that for 1998, a proposal was made to extend scavenging services to ten new locations which involved 433 households. Presently the Council was providing the service to 557 households at 24 locations. The researcher questioned whether it was possible for the Council to serve the ten new locations as the present service was not satisfactory. A member responded by saying that the services to the ten new locations had been done almost a month ago. All these new locations were not " new " in the real sense as the service was already in existence. The new locations were actually the extension of the present service where more houses were included in the service. One member agreed that if Lundu town was to be kept clean, it was important that the ten new extension locations be served as the amount of garbage likely to be generated from these locations were big. All members agreed with this proposal and the Secretary added that fund was available for the service. However the researcher pointed out that no new locations were proposed for Sematan town. A member, the Health Inspector, told the meeting that new locations to be served with scavenging services for Sematan would be implemented after an evaluation had been done on the zoning system at Kampung Stunggang.

However, he pointed out that the scavenging services were concentrated only at the town centers and the sub-urban areas (about five kilometers from Lundu town).

(b) Solid Waste Collection Schedule

In view that the number of houses and premises that were provided with the scavenging services had increased from 557 to 1100 houses, the researcher pointed out that solid waste collection schedule would need to be reviewed based on the following ways;

(i). Two routes system which covered the urban and sub-urban locations.

(ii). Waste Collection Schedules.

This would allow the scavenging units to work on one route per day and collect garbage that were located within the route. This enabled the scavenging units to reduce the travelling time. The two routes would be called Route A and Route B and to be implemented for both towns.

Lundu Town (Appendix R)

For Lundu town, Route A would start at Lundu Secondary School and finished at the ferry points where houses located at the Lundu-Sekambal road, Gibson road, Satu road and Stunggang road would be serviced. There were 566 houses along this route involving 15 locations. The scavenging unit would travel approximately 6 kilometers before discarding the waste at the landfill. The collection day would be Monday, Wednesday and Friday, and waste collection should start at 5.00 am.

Route B for Lundu town would collect garbage at houses at part of the Lundu-Sekambal road, houses at Melintang road and houses at the Lundu-Sematan road. The route would start at the bazaar and finished at the ferry points. This route would be approximately 4 kilometers where garbage at 17 locations involving 420 houses or premises were collected. The collection day would be Tuesday, Thursday and Saturday, and waste collection would be done at 5.00 am

Sematan Town (Appendix S)

For Sematan town, Route A would start at the bazaar and finished at SMK Sematan. This route would be confined to the town centre where 137 houses would be serviced involving 13 locations. The scavenging unit would need only to travel less than 9 kilometers to the landfill. Waste at this route would be collected at 6.00 am on Monday, Wednesday and Friday. In future the Council should extend the scavenging service to Kampung Tanah Hitam.

Route B would start at the bazaar and finished at the Youth Camp. This route would cover more than 12.5 kilometers, and confined mainly to the sub-urban locations. Along this route there were 80 houses at 7 locations. Waste collection would be done at 6.00 am on Tuesday, Thursday and Saturday. In future the Council should extend the service to Kampung Sebat Melayu.

The researcher posed questions to the members for comments. One member said that with this system, solid waste would be collected on alternate days only. This statement was agreed to by the Health Inspector since presently solid waste were collected on alternate days, however with these two routes the scavenging units would only collect garbage that lay within the route. The Secretary responded by saying that with this new system, the

travelling time would be reduced, and the amount of waste collected each day would determine which of the routes collected more garbage.

The researcher pointed out that hopefully, with the implementation of this system, the Council could forecast the future need of solid waste management based on the amount and types of waste collected at each route. The researcher also informed the group that based on his findings, the most common types of waste generated by households at Lundu and Sematan towns were kitchen waste, paper, cardboard and paperboard, plastic, and aluminum and metal cans.(Appendix O).

The Secretary asked group members whether or not they agreed to implement this system. The Health Inspector agreed with the system as it would provide a good structure for future expansion program. All members agreed that this system should be implemented by the Council.

(c) Methods for solid waste management

The researcher informed the group that based on the previous meetings, some measures were made on how best to manage solid waste for both towns. The key elements in keeping a town clean were to have the best and most practical waste management practices. These matters were discussed at length during the last three meetings, and based on that discussions, the researcher put forward the seven elements in waste management practices for Lundu and Sematan towns. These practices were as follows;

(i). The Council should set up Centralised Collection Stations for bigger residential areas. These areas must be divided into zones, and each zone should be made responsible for the management of their own waste. This system could be implemented at villagers (that were accessible by roads), at markets and stalls. The Council would provide bulk bins with the capacity of 1100 litres or more at all centralised collecting stations. The number of houses at each zone should not exceed 30 houses as the waste generated by each house was approximately in the region of 3 to 7 kilograms in a family of more than five people. This was based on the findings made by the researcher while conducting a survey on the weight of waste at all the 24 locations at both towns on the third week of February 1998. The time taken on waste collection would be less if compared to door-to-door collection. The householders would take their garbage to the collecting stations at their own zone. These collecting stations would ideally be placed at road-shoulders.

(ii). The Council should only collect garbage on door - to - door basis at government premises and quarters, schools and housing estates, bazaar and at public places. The number of government institutions and premises were small at both towns and they were located at different places, while housing estates were built in a proper manner according to approved plans where the infrastructures such as roads, drains and houses were arranged in such a way that enabled the compactor truck to pass easily. The bazaar and public places required door-to-door collection as these places generated mostly commercial waste.

(iii). The creation of zoning system at both towns allowed for a better supervision and monitoring on waste management. It was prudent for the Council to get the general public to be actively involved in waste management. One of the best way was to create waste management zones

such as the one implemented at Kampung Stunggang Melayu. The residents of the zones would be responsible for their own garbage in terms of having proper and hygienic waste disposal facilities. The Council would provide waste collecting services by informing the residents the day and time of collection. The role of the Council was confined mainly to the supervision and monitoring of the zones apart from waste collection and transport.

(iv). Systematic collection, transfer and transport- This involved preparing proper collection schedule as well as having a systematic way of collecting garbage which should be based on their locations at town centers and town suburb. The use of compactor trucks either rear - loader or side- loaders equipped with lifting devices would allow easy transfer and transport of garbage to be done from the collecting points to the disposal sites. It was indeed important that the Council should only used wheeled bins as this would enable faster and efficient transfer of garbage from the bins to the trucks.

(v). Bins Management System- The Council should as far as possible manage the garbage bins efficiently so as to allow long and lasting use of the bins. Bigger containers such as the bulk bins should be sprayed with pesticide regularly to kill vectors such as flies which could easily transmit diseases to the human population. As the cost of purchasing bins were borne by the Council, and the cost of bins were expensive, therefore it was prudent that the Council should fence the bin sites. This would stop dogs and other animals from entering or disturbing the content of the bins. It would also provide a clean and tidy environment to road users as bulk bins were located at road shoulders.

(vi). Waste separation technique- It was suggested that the Council should develop a waste separation program which could be done at the town centre and bazaars. Through this system, domestic waste and commercial waste were discarded separately at different bins. Since most of the commercial waste were generated by stores and supermarkets at the town centers, a special container should be placed at strategic locations at the bazaars to allow easy disposal of such waste. Most of these commercial waste were in the form of cardboard or paperboard. By developing this system, the Council would at a latter stage introduce waste recycling as one of a major waste management option.

(vii). Waste management techniques- In waste management, the researcher told the meeting that the most important element was to reduce waste at the source. Therefore by having close working relation with the public, the Council could instill in the mind of the public to discard only unwanted and unused waste only. As more places were going to be serviced by the Council in the near future, it was a general believe that the amount of waste would increase. However, by discarding only the unwanted and unused waste, the amount of waste could be reduced. These unwanted and unused waste were items that could not be re-used such as rotten and dangerous materials. Some kitchen waste such as food left-over could be used to feed chickens and other animals.

At this juncture, the Secretary believed that the Council should maintain a close working relationship with the general public. According to him, it was important to have a sound waste management system as this would reduce

diseases carrying vectors such as flies and rats. He told the group that the Council spent a substantial amount of money in vector control activities. However, it was his believe that the best measure in vector control was by having a good and hygienic solid waste management system. One member of the group suggested that for Lundu and Sematan towns, the best waste management option was to divide the towns into waste administrative zones. The researcher added that such an idea was what was explained earlier on where each zone was held responsible for their own waste management. The Treasurer proposed that as the cost of purchasing bins were expensive, it would be wise if householders were asked to purchase their own bins based on the specifications provided by the Council, or they purchased the bins direct from the Council. This idea was agreed to by all members as it helped to lessen the burden of the Council financially in purchasing bins. At this point, the Secretary requested that he be excused for a while to attend to some official matters outside. The researcher also requested that they had a five minutes break for him and one member to have a smoke outside the office. This was agreed to by all members.

(d) Proposed ways for cleaning the towns

The Secretary asked members to keep silent and requested the researcher to continue with the next agenda. The researcher asked members to ponder on any methods that could help in keeping both towns clean. The Health Inspector said that effort was made in having the general public to participate in town cleaning campaigns but the outcome was very disappointing. The Secretary informed the group that at the district level there were many occasions where the public could participate in cleaning the towns. One member disagreed that since the public always perceived that the responsibility of the Council and the government for that matter was to keep both towns clean. The general public being tax-payers helped by merely paying their taxes. The researcher said that it was only a perception which might not be true. The public would only participate if they were told in advance of any programs on town cleaning, and they were assigned specific tasks to perform during the campaigns. One member elaborated from his past experience of a town cleaning campaign where a lot of people were called to participate. During the campaign the organisers failed to assign tasks to be performed by them, thus most of the members of the public just came, waited for sometime for someone to tell them what to do, no one came, and for a while they went to the coffee shops and had their drink. The Treasurer likened this situation with one of the Parents- Teachers Association's weekend activity that he once attended. It was very unfortunate, according to him, that the organisers came late when half of the parents had gone home. The researcher reminded the group that it was not an easy task to assemble people in a campaign such as this. Thus it was wise for the organisers such as the Council to plan properly if a campaign of this nature was to be organised and to learn from past experience the weaknesses in such campaigns. The researcher pointed out that there were three ways where the Council could get the public to be involved in town cleaning campaigns. These were by;

(i). Establishing A Solid Waste Management Committee.- The Public Health Sub-Committee of the Council could be made the secretariat for this committee. Each zone (solid waste management zones) should appoint

one member to sit in this committee where he or she had powers to deliberate and plan on waste management. Any campaigns that required the participation of the public should be channeled through the zone member.

(ii). Annual Town Cleaning Campaign- By having an annual town cleaning campaigns for example during the Merdeka Day (Independence Day) on the 31st August of each year, the public was made aware of their responsibilities during the Merdeka Day. Each zone was assigned specific task on what they should do and they were required to bring the necessary equipment or tools during such a day. When this campaign was made an annual event, gradually the general public would appreciate what the Council and the government were doing, and they would readily participate, and

(iii). Regular sweeping of both towns- The places noted for having a big amount of waste were the bus terminal, markets, stalls, town drains, shops' backyards and the ferry points. Therefore the street sweepers should concentrate on these areas where town sweeping should be done at 6.00 am in the morning and at about 5.30 pm in the evening. Garbage and rubbish collected at 6.00 am could be sent to the landfills on the same day while those collected in the evening could be sent to the landfills the following day. The number of bins placed at these places must be increased as the amount of waste was big. The markets, stalls and the ferry points in particular generated a lot of garbage, and a bigger bins would be appropriate. Since the Council did not have the roll-on roll-off bins, therefore more bulk bins should be placed at these three places. The researcher told the meeting that the bus companies operating at the bus terminal should also be made responsible for jointly managing the garbage and rubbish. The companies could assist by providing permanent sweepers and standing bins.

The Secretary and one other member referring to the town cleaning campaigns, agreed that if such a campaign was to be organised, the public should be well informed of the program and what roles they were required to do. Nevertheless, the Treasurer added that town cleaning campaigns should be also extended to the nearby villagers. The researcher told the group that the Ministry of Local Government, Kuala Lumpur , organised the Beautification and Cleanliness Program annually where all villagers, schools, government institutions and private sectors participated. The Council should do follow up campaigns from this program to monitor the progress made by the participants. The Secretary requested the Health Inspector to check on this with the Ministry of Environment.

(e) Landfill Management Practices

On this sub-topic, the researcher requested the Health Inspector to elaborate on what he had done after what was discussed during the previous meetings. Having a thick file in front of him placed on a table, the Health Inspector told the group that his section had done the following matters from what was discussed during the second meeting. He said that controlled tipping was done twice a week for the landfill in Lundu and once in two weeks for the one in Sematan. The landfill in Lundu had more solid waste if compared to the one in Sematan. Apart from that the landfill in Sematan was very new and the construction was based on the EIA report prepared by the consultant. He

added that there were no fencing being put up at both landfills as fund was not available yet but stop-gates had been constructed at both landfills to deter unauthorised vehicles from going to the landfills. According to him, pesticides spraying was done every two days to destroy flies, rats and other vectors. The compaction of waste was done once a week at the landfill in Lundu and once in two weeks for the landfill in Sematan. On the whole both landfills were properly managed.

The researcher informed the other group members that the sites of both landfills were too close to human dwellings. However, since land was not under the jurisdiction of the Council, there was nothing much the Council could do about siting of land for landfill. He requested the Secretary to help inform the public to keep away from the landfills as there were numerous unwanted incidents that had happened at the landfills from what was reported in the mass media and television. The Secretary would write to the Village Heads of the nearby villagers on this matter.

(f) Revenue from solid waste management

The researcher requested the Treasurer to comment on his findings on the revenue generated from solid waste management. After going through the findings, the Treasurer was satisfied with the findings and had nothing to comment. The Secretary pointed out that actual revenue generated from solid waste was the one collected from the rate-payers and the contribution made by the government towards solid waste management. According to the researcher, money collected from the rate-payers from 1995 to 1997 was RM 64,863.00, while for the same period the contribution of the government was RM 29,777.00. The major part of the revenue was in the form of capital grant from the state government for developmental purposes. (Appendix K). The group accepted the findings made by the researcher and one member proposed that it would be better for the Council to impose solid waste fee on monthly basis rather than by imposing a yearly rate which was based on the annual assessment rate. The Secretary responded by saying that if the project implemented at Kampung Stunggang Melayu was feasible, then it could be earmarked as a starting point for monthly collection on solid waste fee.

(g) Expenditure on solid waste management

The meeting was told that expenditure on solid waste management was pretty high. The amount spent on landfills for three consecutive years for 1995 to 1997 was RM 17,670.00, while expenditure for wages for the same years was RM 204,106.00. The Council also spent RM 149,674.00 on health activities and purchase of bins. However the amount spent for the repair of trucks was less than RM 30,000.00 for the same years. (Appendix L). The researcher pointed out that so much money was spent on wages and personnel emolument. In future it would be wise for the Council to engage contract workers for the scavenging work as these workers were cheaper and required less supervision. Presently, the meeting was informed by the Health Inspector that three of the packers were contract workers and they were paid less than RM 600.00 per person monthly. This statement was supported by the Treasurer. A member noted that the purchase of bins took a substantial allocation of the Council's fund and he wanted to know whether there was any

fund being received from the government for that purpose. The Treasurer clarified that part of the money was from the Council's operating expenditure while the government allocated RM 50,000.00 for the purchase of bins and other health related projects. The Secretary told the meeting that less money was spent on the repair of trucks due to the fact that all the three trucks for scavenging services were less than five years old, and the money for the purchase of trucks were obtained from the government under the capital grant projects.

At this juncture, the researcher observed that the Health Inspector was looking at his watch several times, and gave little attention to the discussion. The Secretary informed the researcher that he had to fetch his son at 12.00 noon for the afternoon session class. The researcher could perceive that the Health Inspector might also had family commitment but did not tell the group.

As most of the matters that need to be clarified and discussed in the meeting was already discussed, the researcher said it took another five minutes or so before they closed the session. The Health Inspector was relieved and he started putting back all the papers inside his file. However, a member requested that the project that they implemented at Kampung Stunggang Melayu need to be discussed too at the meeting though it was not in the agenda. The researcher apologised for not putting the matter in the agenda. The Secretary agreed that the matter should be discussed, and a member responsible for the implementation of the project was asked to brief the other members.

The member, who was himself a Councillor of the Council told the group that the people of that particular village welcomed the idea and agreed to participate in the project as it benefited the village. However he wanted the Council to assist in the siting of sites for the placement of the bulk bins as the villagers did not actually know the need of the Council. The Secretary requested the Health Inspector to work out the details with the Village Development Committee on the subject. The researcher was asked whether he need to do evaluation study on the project. The researcher responded that the evaluation would be done sometime before the end of 1998 as more time were needed for the villagers to get acquainted with the project so that they could respond well during the evaluation study. The evaluation would be done jointly by the researcher and the other group members.

It was exactly 12.15 am when the researcher told the group that he had no other issues to be discussed at the moment. However he would visit the Council regularly to get feedback on any matters pertaining to solid waste management. He thanked the Secretary and the group members for helping him in the research as all of them gained a lot from the research by actually doing and implementing the work.

(h) Matters agreed at the meeting.

The group agreed to accept and implement all the matters discussed. The Secretary and the Health Inspector promised that the proper management of solid waste in the district would be given priority in the Council health activities. The Council' Sub- Committee on Health would be made more proactive as a venue for solid waste forum.

The researcher on his part expressed his confidence that the Council would take the necessary steps to see that proper management of solid waste was implemented. He however cautioned the Council to be more careful in expanding the areas for scavenging services as the management of solid waste involved a lot of money in terms of manpower, equipment, and other related activities. Though the amount of wastes generated by the public at the moment were small, the impact it had on the lives of the people were big as improper solid waste management could result in the spread of deadly diseases. The role of the Council was to prevent such outbreak of diseases by implementing a sound and effective solid waste management practices.

4.2.5 **Evaluators' Report**

All the evaluators agreed that both towns were dirty. They indicated that places such as the bus terminal, markets, stalls, residential areas, and the nearby villages were full of garbage and rubbish. They believed that the cleanliness of both towns could be enhanced by providing more bins. One evaluator suggested that the bus terminals at both towns should be relocated outside the town centre as the present one were not only dirty but they caused air and noise pollution.

The evaluators agreed that the present system in managing the landfills were acceptable though they commented that the road leading to both landfills should be tar- sealed. On the whole, they proposed that in future, Lundu District Council should establish good working rapport with the general public to educate the public on proper solid waste management. This could be done by way of organising cleanliness and beautification campaigns, and to encourage nearby villages to operate a small hygienic dumping place to discard their garbage if the scavenging services were not provided.(Appendix V)

4.2.6 **Summary**

From 9th January 1998 to 20th April 1998, the Action Research Group managed to hold four meetings to discuss ways to clean both Lundu and Sematan towns. To assess public opinion on solid waste management by the Council, questionnaires survey was done, and the result showed that a majority of the 60 respondents indicated that both towns were dirty.

The group decided to formulate action plans that could help in keeping both towns clean, and to implement a project at one of the villages with a view to encourage public participation in solid waste management. Based on the discussions of the group at four of the meetings, the matters that were agreed to be implemented were;

(a.) The Council should allocate more bins at both towns.
(b.) Proper waste collection time and schedule should be implemented.
(c.) The collection of garbage should be done based on the collection routes to reduce travelling time.
(d.) The Council must implement solid waste zoning system to encourage public participation in solid waste management.
(e.) The use of a centralised collection station at villages and residential areas would enhance a cleaner environment.

(f.) The sweeping of both towns should be done regularly
(g.) which should include cleaning the drains, streets and
(h.) backyards of shops.
(i.) The Council should establish Solid Waste Management
(j.) Committees for both towns as venues for discussion on
(k.) proper solid waste practices.

Thus in trying to keep both towns clean, the group believed that the roles played by the Council (solid waste management agency), and the general public, through the Town Committees and the Village Development Committees, were of paramount importance as cooperation of both bodies could help in creating awareness on having sound solid waste management system and practices.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.0 Brief summary of the study

In the course of the study, the overview of the roles played by Lundu District Council as a solid waste management agency, and the problem of solid waste management was discussed in Chapter One. Solid waste was poorly managed by the managing agency, thus resulting in both towns being dirty. While in Chapter Two, a review of the literature on solid waste which was based on the practise in Europe and the United States of America where the four hierarchies of a sound solid waste management practices were discussed. These four hierarchies are waste reduction at source, reuse of solid waste where certain waste can be reused if properly treated, waste recycling as an option to reduce waste from going to the landfills or incinerators, and waste recovery by way of disposal to either the landfills or the incinerators. A brief explanation was made on the proper management of the landfill as the best option in waste recovery adopted by the Council. Discussion was also made on waste collection system which comprised of the centralised collection stations, the collect system and the bring system for domestic and commercial wastes.

Chapter Three dwells with the action research methodology used in this study. In action research, the focus is centred on real-life problem of the organisation. To discover ways and methods in finding solutions to a problem, an action research group was formed. The core business of the group was to formulate practical practices which could help in formulating solutions to a problem. In this group, the researcher acted as a facilitator to guide and coach the group to ensure that they were on the right track. The focus of the group was to answer questions on the thematic concern of the general public, community leaders and government officials. The thematic concern was a dissatisfaction on the general cleanliness of Lundu and Sematan towns.

While in Chapter Four, the roles played by the action research group was explained in detail. The action research group developed ways to alleviate solid waste problem through a series of meetings that involved planning, acting, observing and evaluating group members. The findings of the group were done based on brainstorming and sharing of ideas that could be used in implementing a sound solid waste management practices. Thus the group agreed that proper solid waste management for both towns could be enhanced by way of having a proper waste collection schedule, developing waste routes to serve the town centres and the outskirts, creating zone system for waste management where public participation was important, creating a solid waste management committee as venue for discussion on the subject matter, regular sweeping of both towns, providing sufficient bins at both towns, implementing the centralised collection stations at nearby villages and residential areas, implementing a proper landfill management system, and getting the public to be involved in solid waste management by way of working closely with them.

5.1 Conclusion

In conclusion this study attempted to answer the research questions which outlined the processes involved in looking for solutions to problem of both towns being dirty. These research questions are;

5.1.1 What are the current level of satisfaction in regard to solid waste management at both towns ?

Based on the questionnaires survey, interview and the evaluators' report, the respondents agreed that both towns are dirty. The observation made by the researcher on the general condition of both towns was agreed to by the action research group members. They agreed that the bus terminals, markets, stalls, backyard of shops, town drains and streets are dirty. This is due to lack of bins, poor management of garbage and rubbish, poor waste collection schedule, the towns are not swept properly, and poor public involvement in waste management at both towns. The nearby villages and residential areas are dirty because the Council does not provide scavenging service to those areas.

5.1.2 What are the critical factors involved in an effective solid waste management practices for both towns ?

The action research group agreed at their meetings that Lundu District Council as the major player in solid waste management for both towns must implement the following proposals if an effective solid waste management practices are to be developed;

(a) The Council should have a proper solid waste collection schedule so that wastes are collected on time and on the right day. This will enhance the cleanliness of both towns.

(b) The collection of solid wastes is proposed to follow the two route system which are route A for the outskirts of the town, and route B for the town proper. By following this system, the Council through the scavenging units will reduce travelling time and consistent collection of garbage is guaranteed.

(c) The introduction of the Zoning System will allow greater public cooperation in managing their own garbage. The public will be responsible in managing their own garbage based on their own zones. They will render support to the Council by keeping the bins in a proper manner. This system will allow greater use of the bulk bins as few houses will share the same bins.

(d) The formation of a Solid Waste Management Committee will enable the Council and the general public, in particular the Town Committee and the Village Development Committee, to work closely with each other on solid waste management.

(e) It is found prudent that regular sweeping of both towns would enhance the towns' cleanliness. The towns' drains, shops' backyards , bus terminals,

(f) streets, markets, stalls and ferry points need to be swept twice a day. This can be done at 6.00 in the morning and at 5.30 in the evening when the towns are quiet and free from human activities.

(g) The Council should provide enough bins at the town centres and at the nearby villages and residential areas. By having sufficient bins, the public will be able to dispose their garbage at the proper places.

(h) The use of the Centralised Collection Stations will allow easy and fast collection of garbage. It will also encourage the householders to share the responsibility of managing their own garbage as these stations will be shared by a few householders.

(i) The Council is advised to have a proper management of the landfills. The control over the flow of leachate and other hazardous gases will not be detrimental to public health. Likewise, control over breeding of flies and other vectors that could transmit diseases could secure public health.

(j) The most important element in having a sound solid waste management is public participation. Since the general public are the major contributor of solid waste (domestic waste), therefore the Council should work closely with the public through the Zone System and the Solid Waste Management Committee.

5.1.3 To what extend are Lundu District Council and the general public involved in solid waste management at both towns aware of the dimensions of solid waste management ?

By setting up of the solid waste management committee, the creation of the zone system and the establishment of the centralised collection stations, both the Council and the general public are working together in managing solid waste at both towns. Some of the solid waste management practices that was practised in Europe and the USA, has been practised by the Council for a long time. However certain new measures, such as recycling program, proper waste collection stations, the use of incinerators and proper treatment of solid waste for better use, are new for the Council but they are aware of these new measures, and only with sufficient fund could they implement these programs.

5.1.4 What are the level of readiness of Lundu District Council in contributing to the improvement on solid waste management at both towns ?

The Council is prepared to implement all the suggestions as proposed by the action research group. In view that most of the members of the group are senior officers of the Council, and solid waste management is their major responsibility in terms of public health, therefore the suggestions made by the group are most crucial in developing an effective solid waste management practices.

During the research period, the researcher played the role of a facilitator and a researcher to the action research group. This role included planning for the meetings which comprised of preparing notes, meetings' agenda, taking notes on the discussion for use in subsequent meetings, guiding the group to focus mainly on the subject matter, observing group members' behavior during the meeting, and to ensure that the meeting was conducted as schedule.

The researcher was also responsible for collecting and compiling data which would be used in the meetings. These data were collected through the questionnaires survey, interview, site observation of both towns and the landfills, and documents obtained from the Council office with the help of the group members. Any matters discussed by the group based on the data would be recorded and later on given to group members for verification which would be discussed further in the subsequent meetings. The group members gave feedback and input based on the information that they had. These feedback and input would be incorporated into the findings.

The most important lesson that the researcher learnt was that group discussion was successful if preparation was done before hand, and members were told in

advance what was expected of them. Every member was given a fair chance to express their feelings, and knowledge was shared without prejudice to their educational background or position in the organisation. The researcher acknowledged that working with the group was interesting and new experience was gained through group's learning.

5.2 Recommendations for Effective Solid Waste Management Practices

For the purpose of this study, the recommendations for effective solid waste management practices that could be adopted by Lundu District Council are of the general and specific recommendations. These recommendations are formulated in such a way that they could be implemented through the strategic, tactical and operational programs. These recommendations and programs are outlined below;

5.2.1 Strategic Programs

These programs could be implemented in future. The time frame is a period within the next five years or more when the Council is expected to be stable in finance, human resources and more focus in its solid waste program. Under this program, it is proposed that the Council should implement the following recommendations;

(a) Recycling Program- The Council is expected to start the recycling program as one of its major activity in solid waste management. Items that could be recycled need to be identified so that enough fund could be set aside for this purpose. The Council is also encouraged to identify possible markets or industry that could assist it in the recycling program.

(b) Sanitary Landfill- As the landfill is opted as the best waste disposal facility, the Council needs to plan to have a sanitary landfill or improve the present landfills. Matters of concern such as leachate discharge, gas production and health hazard to the public should be given priority in its future plan on having a sound sanitary landfill.

(c) Replacement of equipment- Equipment such as the compactor trucks need to be replaced once they are more than five years as the cost of repair is expected to rise and uneconomical. Fund should be made available for this purpose as more areas are going to be covered in the near future.

(d) Human resources requirement- The need for more personnel in managing solid waste in the future would cause more allocation towards human resources requirement. Therefore it is advisable for the Council to engage contract-workers in the future as this would cost less fund in terms of wages or other matter relating to personnel emolument. Given a steady financial footing, the Council is strongly advised to privatise the scavenging services with a view to reduce expenditure on such services.

5.2.2 Tactical Programs

Under the tactical program, the Council is expected to implement the programs or recommendations within a period of less than five years. The focus of these programs are specifically designed to be implemented by the Public Health section. The recommendations are;

(a) Increase area of coverage

The Council through the Public Health section is expected to increase its area of operation in terms of providing scavenging services for Lundu and

Sematan. The villages and residential areas near to the town center must be provided with the services if both towns are to be kept clean at all time.

(b) Increase public participation in solid waste management

As the public is the major contributor of solid waste, then it is prudent that their involvement in managing solid waste should be given priority. The Council needs to create public awareness in solid waste management by way of having close working relation with the Town Development Committee, Chinese Chamber of Commerce and the Village Development Committee of both towns.

5.2.3 Operational Program

These programs need to be implemented immediately as the delay in the implementation could cause undue difficulties to the Council. The recommendations under this program are;

(a) Solid waste collection system and schedule

The present system of waste collection which is done daily and three times a week is recommendable. However as the bazaars generate more waste, thus daily collection is recommended to be implemented at bazaars of both towns. The collection should start at the farthest collection locations before moving to collect waste at the town center. This is applicable for Lundu town. As for Sematan town, the collection should begin with the town center before moving to the farthest collection locations as the landfill is located midway between the route.

(b) Bin System- It is recommended that wheeled-bins or mobile garbage bins (MGB) are to be used at all locations. The bins must be durable and strong, preferably of the HDPE type. The wheeled-bins or MGB allow easy movement of the garbage rather than having the packers to carry the bins on their shoulder. These bins are specially designed to enable them to be hauled into the truck via the rear-load lifting device. With the use of the wheeled-bins or MGB, the time taken to collect, haul and transfer garbage onto the truck is shortened.

(c) Establishment of a Solid Waste Management Committee

It is crucial for the Council as this point of time to establish a Solid Waste Management Committee. This committee should have members representing the locations or regions being provided with the scavenging services. The main role of this committee is to assist the Council in managing solid waste at the regional levels. The Council becomes the Secretariat for this committee, and the decision of this committee shall be discussed or agreed at the Full-Council Meeting where appropriate action must be taken.

(d) Improvement on landfill management

The need to improve the management of the landfills is crucial. Being the only waste disposal option at the moment, the landfill plays an important role in ensuring that the garbage are properly discarded and managed. The Council should put up fences and gates at both landfills to deter dogs and human scavengers from entering and loitering at the landfills. It is also recommended that garbage should be earthfilled or compacted regularly to avoid flies, rats, and other vectors from breeding. These vectors, if not properly controlled, could cause diseases to the human population.

(e) Improvement on street and town sweeping.

The sweeping of the streets and the towns must be done twice a day. One in the early morning at 6.30 am when there were less people on the streets, and the other one in the late evening at 5.30 pm when the shops were closed for business. The activities must include cleaning the drains, shops backyards, bus terminal, markets, stalls, public places and town streets.

(f) The use of plastic bags

The Council should enforce by-laws to make it compulsory for the garbage to be placed in plastic bags before they are thrown into the bins. This is not only hygienic but it allows easy removal of garbage into the truck and finally it helps to deter flies, rats and other vectors from breeding and feeding on the garbage.

(g) Roadside or Curbside bins placing

It is recommended that all the bins must be placed at the roadsides. For individual bins, the location should be at the road shoulders so as not to hinder traffic, while bulk-bins should be placed at specially built area and it must be fenced. This system will allow easy collection as the packers need not have to move too far from the compactor truck. Therefore less time is used to collect garbage at all locations.

(h) Putting up of Billboards

The Council must put billboards at strategic locations to remind the public on the need to keep the town clean. Public places such as the bus terminal, markets and stalls, ferry points, government offices, schools, village halls and town square are strategic locations where billboards must be placed. The wording of the billboards must be catchy, simple, and easy to be understood by the general public. The purpose of the billboards is to inform the public on how to maintain a clean and healthy environment. The contact number in the form of telephone numbers, facsimile numbers or electronic mail address of the Council must be displayed at the billboards to enable the public to report, help, or make complaint on solid waste issues.

(i) Training of Human Resources on proper solid waste management

This is the most important element in having an effective solid waste management system. The personnel in the Public Health section such as the Health Inspector, Public Health Assistants, clerks and packers must undergo training related to waste management. They must be exposed to the latest technology in waste management techniques such as recycling, landfill management, environmental management and other related subjects on proper solid waste management. The personnel in this section must undergo training at least once a year at approved training center or undergoing attachment at solid waste management agency. The Council must provide sufficient fund for this purpose.

(j) The implementation of the Centralised Collection System

This system is applicable for villages, residential areas and schools. The Council with the assistance of the householders must identify suitable locations where a Centralised Collection Disposal Facility (CCDF) must be placed. This system allows for easy management of solid waste in terms of collection, transfer and transport. It also enables the householders to share the responsibility of collectively managing their garbage. The householders need only to carry their garbage to the CCDF which maybe a few meters from their houses. The mode of payment for this system must be billed monthly based on the amount of garbage discarded and the distances from the landfill. This will help the householders to reduce waste at source.

(k) Safety and Healthy Working Environment

It is critical for the Council to create a safe and healthy working environment for the packers. A safe working environment is a situation where the occurrences of accidents and injuries are minimal. In this aspect the machines, equipment and compactor-truck must be safe to operate. It is prudent that these equipment, machines and truck be inspected regularly to avoid untoward incidents to occur. A healthy working environment is a situation where illness and other sickness are minimal or under control. Since the packers are exposed to illness originating from unhygienic condition of the solid waste, it is important that their health must be checked regularly. It is advisable that they go for medical check at least once a month.

(l) Increase the number of bins at towns and strategic places

Based on the Questionnaire survey conducted, it is learned that there are not enough bins of various sizes being placed at the bazaars, town zone and other strategic place. Sufficient number of bins must be placed at places such as the town square, the bus terminal, markets and stalls, ferry points, schools, and government offices. The sizes of the bins will depend on the amount of waste that a particular location is likely to generate. For places such as the bus terminal, the use of stand-bins is sufficient as the type of waste likely to be generated are plastic wrappers and other non bulky items. The bins that need to be placed at the markets and stalls must be of large size preferably large volume mobile bulk bins of 1100 litres or more. These places generate a large quantity of waste in the form of unwanted food, vegetables and meat. Hanging bins are advisable to be placed at the town square, bus waiting sheds, and children playground. The Council should also provide special bins for the collection of commercial waste such as paperboards so that it will not take up more space if placed together with the domestic waste in the same container. These special bins or containers must be placed at the back of the shops so that it does not create unkempt scenery if it is placed at the five foot way of the shops. All shops must use the mobile garbage bins and they must be placed at the front of the shops but keeping in mind that they do not obstruct the five foot way.

(m) Waste Collection route

It is proposed that for Lundu and Sematan , there must be two collection routes. The purpose is to minimize travelling time of the scavenging units. . A collection point is a point where the scavenging unit collect, load and transport the waste from that point to the landfill. In a collection point, they are few houses having either the individual bins or the Centralised Collection Disposal Facility (CCDF). It is proposed that the following routes are followed;

Lundu Town

There are going to be 29 collection points at Lundu town based on routes A and B.

Route A

Thus for Lundu, the first collection route (Route A) will start at SMK Lundu (1st point) along the Lundu-Sekambal road to collect waste at the school, then to Kampung Sebemban (2nd point), then proceeding to collect garbage at the National Park (3rd point), then at the JKR pump house (4th point), then at Kampung Pulo Ayer (5th point), before proceeding to Gibson road to collect garbage at Sileng Ulu (6th point), and then at Kampung Sileng (7th point). From there waste at the town zone and government offices (8th and 9th points) are collected. Waste at the town centre (10th, 11th and 12th points) are collected before the scavenging unit proceed to collect waste at Kampung Dagang, Kampung Stunggang Melayu and finally at the ferry points (13th, 14th and 15th points). Basically this route serves the outskirts of the town, and a total of 566 houses are being serviced. This route will start on Monday, Wednesday and Friday. Waste collection is proposed to be done at 5.00 in the morning, and it is anticipated that about 4 tons of solid waste are collected.

Route B

Route B will consist of 17 collection points which begin at the Bazaar (10th point), then the markets and stalls (11th point), then houses at SRK Bumiputera (16th point), then the Education office (17th point), then the hospital (18th point), then the state quarters, District office and Taman Jaya (19th , 20th and 21st points). From there the unit proceed to collect waste at houses along Melintang road, LDC quarters and SRB Chung Hua (22nd, 23rd and 24th points).

The final stage of the journey involves collecting waste at the Police barrack, Kampung Sungai Lundu, houses at Kedaong road, Kampung Seketi, and the federal quarters (25th, 26th, 27th, 28th and 29th points). The last part of the journey involves collecting solid waste at the ferry points (15th point) before the truck full with garbage goes to the landfill nearby.

At Route B, a total of 420 houses will be served, and an approximate 4 to 5 tons of waste are collected. This route will cover approximately 4 kilometers. It is proposed that waste collections are done on Tuesday, Thursday and Saturday along this route. Basically this route covers the town centre. (Appendix R).

Sematan Town

As for Sematan town, there are 18 collection points based on routes A and B. These routes are;

Route A

Route A which consists of 13 collection points will begin at the Bazaar and the town centre (1st point), then the residential lots (2nd point), then SRB Chung Hua (3rd point), then the market and stalls (4th point). The unit then proceed to

collect garbage at the Army camp, District office and quarters, (5th and 6th point), then the Health clinic, Police barrack and SRK Sematan (7th, 8th and 9th points) along Residential road.
From there the unit proceed to collect garbage at Telecom, LDC quarters and the Fishery department's quarters (10th, 11th and 12th points). The final stage would be collecting garbage at SMK Sematan (13th point) before waste are transported to the landfill about 6 kilometers away. There are 137 houses along this route, and the amount of waste to be collected daily are approximately 2 to 3 tons. This route is approximately 3 kilometers. Basically this route serves the town centre. It is proposed that waste collections are done on Monday, Wednesday and Friday. A new area that should be covered by this route is Kampung Tanah Hitam.

Route B

Route B which consists of 7 collection points begin at the Bazaar and the town center (1st point), then the market and stalls (4th point), then proceeding to collect waste at SRK Sebat (14th point), then Kampung Sebat Dayak (15th point), then SRK Pueh (16th point), then Kampung Pueh (17th point), and finally the Pueh Youth Camp (18th point). This route is the longest since it covers 12.5 kilometers. The landfill is along the way to the Youth Camp. The scavenging unit spends most of their time travelling to far away collection points. Along this route there are 80 houses, and the amount of waste estimated to be collected is between 2 to 3 tons. It is proposed that waste collections are done on Tuesday, Thursday and Saturday. Basically this route serves the outskirts of Sematan town. A new area that should be included in this route is Kampung Sebat Melayu. (Appendix S)

Specific Recommendations for Lundu and Sematan Towns

For both towns, the specific recommendations consist of the following;

(i). The Implementation of the Zoning System- This system is proposed to be implemented at existing and new areas such as Kampung Dagang, Kampung Sileng, Kampung Sungai Lundu, Kampung Seketi, Kampung Sekambal and Kampung Sebemban for Lundu. The existing and new areas in Sematan that are proposed to adopt this system are Kampung Tanah Hitam, Kampung Sebat Melayu and Kampung Sebat Dayak. A Working Committee must be established at each village to liase with the Council on solid waste management. This committee is required to identify suitable sites in the village where the CCDF are to be constructed. The cost of construction is to be borne jointly by the Council and the committee. The Council is responsible for waste collection, and the committee is responsible for ensuring that the monthly fee is paid to the Council and the management of waste at the village level is proper and hygienic.

(ii). Cleaning of the Town Center- The town center is proposed to be swept two times a day which are in the early morning and at late evening. The cleaning of the town center must include the drains, shops backyards, bus terminal and the market and stalls. The Sarawak Transport Company and the Bau Transport Company, the bus companies operating the terminal must be made responsible in keeping the terminal clean by providing enough bins at the terminal.

(iii). The Chinese Chamber of Commerce- The chamber is held responsible for keeping the town center clean. The Council and the chamber should organize cleanliness campaigns by way of undertaking general cleaning of the drains,

shops backyards, markets, stalls, bus terminal and the town square. All business and trading bodies operating in the town center must be required to participate in the general cleanliness program. This program must be initiated by the Council and agreed to by the District Development Committee who will instruct such a program to be organised. The program can be done twice a year during the celebration of the New Year (1st January) and during Malaysia Day (31st August).

(iv). The compulsory use of Wheeled Bins- The Council must make it compulsory for all shops and business firms to use the 2 Wheeled bin (or Mobile Garbage Bin). This bin allows for easy movement by the packers and the bin is designed to enable it to be hauled easily into the truck by the hydraulic lifting device attached to the truck. The bins must be placed at the front of the shops but they must not obstruct the public way along the five-foot ways. These bins are used mainly to keep domestic waste. Other commercial waste such as paperboards must be kept in special containers or bins, and they must be placed at the back of the shops.

5.3 Contribution in the field of Human Resource Development

The contribution of this study in the field of human resource development could be seen in three major aspects which are:

5.3.1 Training of council staff on solid waste management

In the field of human resources, training is meant to assist individual to acquire new skills and knowledge. Through training, an individual is expected to develop a positive attitude towards his or her job. Therefore, this study can assist the council to come up with a training program tailored towards the needs of the council in particular the Public Health section. The training program should be made with a view to improve performance on the current job of the packers and the supervisory staff of the Public Health section. Thus it is prudent that the packers and the supervisory staff should be made aware of the new technology in solid waste management so that they can apply what they have learned on their job. In designing a training program, the council should identify the training needs of each packer and the supervisory staff. In this respect both on-site and off-site training methods should be done. On-side training method is to be done at the workplace where packers and the supervisory staff are expected to undergo orientation program on new technology pertaining to solid waste management, and they are required to do the task on the job. If need be, the council should put up a program where certain junior staff are to go on job rotation so as to expose them to the real situation in collecting and disposing garbage. In order to equip the packers, other junior staff and the supervisory staff with new technology in the management of solid wastes, off-site training should be encouraged. These staffs are to be sent to other training institutions where they are exposed to the latest method in solid waste management through lectures, audiovisual aids, and equipment simulators. This will assist them in doing their job efficiently.

5.3.2 Educating the General Public

From the observation of the action research group, the general public is the major player in solid waste management. They disposed garbage everyday and they are responsible for the cleanliness of their environment. Therefore making the general public aware of their responsibility in keeping a clean and healthy environment is the most important aspect of the health education program of the

council. The program should be made in such a way that it is not only educative but most important is to create awareness in the general public that the management of solid wastes should begin at home. This program can be done with the help of the Medical Department, the District Office, the Information Services Department and the Village Development Committees. Topics related to solid waste management and personal health should be discussed at meetings, civic assemblies and meet-the-people session. Thus the creation of a Solid Waste Zoning System is seen as an important element in getting the general public to be fully involved in the management of solid wastes at their own zones.

5.3.3 Self- Development of the Action Research Group Members

The action research group members are learning specialists at the end of this study. They become the facilitator of learning that could assist the council in preparing training programs pertaining to solid waste management. During the brainstorming session at the action research group's meetings, new ideas, concepts and technologies pertaining to solid waste management were discussed. Therefore the action research group members had acquired tremendous knowledge on the latest methods in solid waste management. Thus they are expected to play the role of internal consultant for the council in terms of solid wastes management. The members of the action research group in particular the senior members of the council are expected to identify future changes that might have impact on the council where solid waste management becomes more demanding and costly. Thus it is important that whatever knowledge that had been acquired by the senior members of the council should be put into practise where recruitment, selection, placement and compensation of the employees at the public health section is concerned. Thus only those suited for the post of packers, sweepers and supervisory personnel should be considered. It is believed that the management of solid wastes in the near future is more demanding and costly.

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KEMENTERIAN ALAM S
TINGKAT 8,
WISMA BAPA MALA
PETRA JAYA
93502 KUCHING

5 Januari, 19

Rj. Tuan:

Rj. Kami: KAS/KT/P/3091 ( )

Setiausaha,
Majlis Daerah Lundu,
LUNDU

Tuan,

Kajian Keatas Pengurusan Sisa Pepejal (Solid Waste) Di Lundu

Dimaklumkan bahawa Encik Bujang Haji Budin, Penolong Setiausaha, akan menjalank kajian keatas pengurusan sisa pepejal di majlis tuan sebagai tesis untuk M.Sc(HRD) UNIMAS

2. Kajian ini akan mengambil masa selama 16 minggu mulai 5 Januari 1998. Kaji ini amat berguna di dalam membantu pihak tuan merangka strategi yang berkesan dalam pengurusan sisa pepejal. Adalah diharapkan juga kajian ini kelak dapat digunak di dalam membantu pihak tuan mencari jalan menambah pendapatan melalui pengurus sisa pepejal yang sistematik.

3. Oleh yang demikian tuan adalah diminta memberi kerjasama kepada beliau dalam menjalankan kajian ini nanti.

Sekian, terima kasih.

'BERSATU BERUSAHA BERBAKTI'

Yang benar,

(ABANG OTHMAN ABANG FATA)
b.p. Setiausaha Tetap,
Kementerian Alam Sekitar

ppb/...

Appendix B

Questionnaires on Solid Waste Management for Lundu and Sematan towns

Instruction

This Questionnaires consists of 4 parts which are as follow;

A. Personal Data
B. Your Opinion on Solid Waste Management at present
C. Your suggestion(s) on improvement
D. Your suggestion(s) for implementation

This Questionnaires contains 31 questions, and you are to answer them based on what you observe and know.

A. Personal Data

1. Your Name:
2. Permanent Address:
3. Profession:
4. Age:
5. Workplace:

B. Your opinion on Solid Waste Management at present.

6. In your opinion is solid waste management at present satisfactory?
   a) Yes
   b) No
   c) Not sure
7. Where are the places that you think have the most solid waste (garbage)?
   a) Nearby villages
   b) Bazaar
   c) nearby river
   d) nearby schools
   e) others, please specify_____
8. Are the use of bins as waste disposal method satisfactory?
   a) Yes
   b) No
   c) Not sure
9. Are there enough bins being placed at the town ?
   a) Yes
   b) No
   c) Not sure
10. In your opinion what are the types and built of bins that are durable and lasting ?
    a) plastic
    b) metal
    c) hard plastic of PVC or HDPE

11. In your observation are solid wastes being discarded properly in the bins at the town. What are your comments?
    a) Yes
    b) No
    c) Not
    My comment(s)_____
12. In your opinion is the scavenging truck big enough for solid waste disposal?
    a) Yes
    b) No
    c) Not sure
    d) Others, please specify_____
13. From your observation, what types of wastes are commonly disposed?
    a) household waste
    b) boxes and plastic
    c) scrap iron
    d) paper
    e) Others please specify_____

C. **Your suggestions for improvement.**

14. What are the best methods for solid waste disposal?
    a) landfill
    b) reduction at source
    c) burning
    d) recycle
    e) others, please specify:
15. When should solid waste be collected?
    a) early morning
    b) evening
    c) at night
    d) others,please specify:
16. Where should the bins be placed?
    a) roadsides
    b) at the town/bazaar
    c) nearby villages
    d) others, please specify:
17. Are Lundu and Sematan towns clean?
    a) Yes
    b) No
    c) Not sure
18. In your opinion what are the ways to clean the towns?
    a) provide more bins
    b) sweep the towns often
    c) others, please specify:

19. Are the collection time at residential areas satisfactory, and what are your suggestions?
    a) Yes
    b) No
    c) Not sure
20. In your own words, state the apparent weaknesses that you can see in the present solid waste management ?
21. In your opinion what are the ways to solve them?

D. **Your suggestions for implementation.**

22. Solid waste collection time. Base your choice for your own town.
    A. The following time is proposed as collection time;
        1. 5.00 am at _____
        2. 7.00 am at _____
        3. 8.00 am at _____
        4. Other suggestion _____
    B. The following collection methods are proposed;
        1. Bring system
        2. Centralised collection system
        3. Collect system
        4. Other suggestion _____
    C. Waste collection schedule;
        1. Daily
        2. Twice a week
        3. Three times a week
23. Placement of bins at the following places should be at;
    1. Town
        a) bus terminal
        b) markets
        c) children playground
        d) backlanes of shops
        e) town square
        f) ferry points
        g) others please specify_____
    2. Nearby villages;
        a) road entrance
        b) middle of village
        c) others, please specify_____
    3. Nearby schools;
        a) road entrance
        b) canteen
        c) others, please specify_____

4. Government buildings;
   a) back of buildings
   b) place specified by departments
   c) others, please specify_____
5. Residential houses;
   a) at the front of house
   b) at the back of house
   c) others, please specify_____

24. Awareness campaigns should be done by;
   a) Public Notification
   b) No Littering Billboards
   c) Cleanliness campaigns
   d) others, please specify_____
25. At the towns- the following places must be kept clean always;
   a) bus terminal
   b) markets
   c) backlanes of shops
   d) five-foot ways
   e) drains
   f) children playground
   g) town square
   h) others, please specify_____
26. Solid waste management- The following ways must be implemented in future;
   a) reduction at source
   b) recycle
   c) closed landfill
   d) incinerator
27. Recyclable items must be provided with recycle collection stations at;
   a) bazaar
   b) schools
   c) nearby villages
   d) others, please specify_____
28. Landfill management should take into account the following factors.
   a) no open burning
   b) keep close from public
   c) far from residential places
   d) free from rodents, dogs, flies and other vectors
   e) no health hazard
29. The Council should have avenues for solid waste complaint in the form of;
   a) hotline
   b) contact officer
   c) solid waste management committee
   d) solid waste mobile unit(s)

30. The Council should provide paid services for the following;
   a) garden waste
   b) construction waste
   c) scrap from workshops
   d) others, please specify_____

31. The people who indiscriminately discard solid waste should be punished as such;
   a) do social work
   b) fine with option for social work
   c) fine in default imprisonmen

(Note: This is a translated text from Bahasa Malaysia. The questionnaires given to the respondents were written in Bahasa Malaysia.)

Appendix B (1)

Summary of Questionnaires Survey on Solid Waste Management.

No	Questions	Answers	Result
1	Satisfaction on service	No	69.2% not satisfied
2	Areas having most waste	Villages/bazaar/river	90% agreed
3	Satisfaction on bins	Satisfied	84.60% satisfied
4	Are they enough bins in towns	Not enough	73.10% agreed
5	Preferred bins	HDPE type	92% agreed
6	Is waste properly discarded in towns	No	73.10% agreed
7	Is truck big enough	Yes	65.40% agreed
8	Common type of waste	kitchen/boxes/plastic/paper	71% agreed
9	Best methods for waste disposal	landfill	80% agreed
10	Waste collection time	early morning	67% agreed
11	Where bins must be placed	villages/bazaar/roadsides	65% agreed
12	Are towns clean	No	65.40% agreed
13	Ways to clean towns	gotong royong/more bins	91% agreed
14	Are collection time at residential satisfactory	No	65.40% agreed
15	Weaknesses in SWM	poor collection schedule & not enough bins	84% agreed
16	Ways to solve them	a) Increase number of bins b)Provide collect centers c)Proper collection time	78% agreed
17	SW collection time	At 5.00 am for Lundu. At 7.00 am for Sematan	61% agreed
18	Collection methods	a) Centralised collect points b)Collect system	77% agreed
19	Waste collection schedules	a) Everyday b) 3 times/week	69% agreed
20	Placement of bins(towns)	bus terminal/markets/child. playground/shop backlane town sq/ferry points	69% agreed
21	Placement of bins (kpg)	a) road entrance b) middle of village	69% agreed

Continue Appendix B(1)

No	Questions	Findings	Results
22 (3)	Placement of bins (school)	road entrance/canteen	65% agreed
22 (4)	Placement of bins(office)	designated area	58% agreed
22 (5)	Placement at residential	Front of house	85% agreed
23	Awareness campaigns	notification/billboards/ cleanliness campaigns	54% agreed
24	Places be kept clean at towns	bus terminal/markets shop backlanes/five-foot ways/drains/child playground/town sq	54% agreed
25	Future management of Solid waste	a) Recycle b) closed landfills	58% agreed
26	Location of recycle stations	a) Towns b) Schools c) nearby villages	58% agreed
27	Landfill management	no open burning/keep close/far from houses free from animals & flies no bad odor/no health P	77% agreed
28	Waste complaint avenues	hotline/waste mgt comm/ waste mobile unit	62% agreed
29	Waste paid services	a) construction waste b) scrap waste	58% agreed
30	Punishment for waste throwers	a) social work b) fine and social work	73% agreed

Appendix C

Interview Form on Solid Waste Management for Lundu and Sematan Towns

A. Biodata Sendiri (Personal Biodata)

1. Nama (Name):
2. Pekerjaan (Job):
3. Umur (Age):
4. Tempoh perkhidmatan (Length of service):
5. Berapa kerap anda menjalankan pemeriksaan kesihatan ? (How often do you undergoing medical check-up ?).

B. Jenis Kerja (Job Specification)

1. Nyatakan apa yang anda buat (Tell me what do you do) ?
2. Nyatakan masa anda bekerja setiap hari (Tell me the hours you spend working daily)
3. Pukul berapa anda mula kerja (What time you start working) ?
4. Nyatakan jumlah hari anda bekerja seminggu (Tell me the number of days you work weekly) ?
5. Anda suka kerja ini (Do you like this job) ?

C. Tugas Anda (Your job)

1. Berapa banyak tong sampah yang dipungut sehari (How many bins you collect each day) ?
2. Dari apa yang dilihat, apakah isi tong tersebut (From what you see, what are the contents of the bins) ?
3. Dari kawasan mana (From which localitiies) ?
4. Jarak diantara tong tersebut (The distance between the bins) ?
5. Nyatakan keadaan tong tersebut (Tell me the conditions of the bins) ?
6. Kawasan mana yang paling banyak sampah (Which area has the most waste)
7. Apakah jenis sampah di kawasan itu (What are the nature of waste in that place)?
8. Adakah truck mempunyai alat pengangkat. (Does the truck has a lifting device).
9. Pernahkah mendapat rungutan dari orang awam (Do you ever receive complaint from the public)?
10. Apakah jenis rungutan itu, dan apa yang anda buat (What are the types of complaints, and what do you do)?
11. Bagaimana sampah diurus di tempat pembuangan sampah (How are wastes being managed at the landfill)?
12. Berapa jauhkah tempat pembuangan sampah dari pekan (How far is the landfill from the town)?
13. Ceritakan lebih lanjut mengenai tempat pembuangan sampah (Tell me more about the landfill)?
14. Adakah sungai atau kampung berdekatan dengan tempat pembuangan sampah (Is there any river or villages near the landfill)?
15. Berapa banyak sampah yang dihantar ke tempat pembuangan sampah setiap hari (What is the volume of waste that are sent to the landfill daily)?
16. Pada pengamatan anda sampah yang jenis manakah yang paling banyak dihantar ke tempat pembuangan sampah (From your observation what type of waste are most common disposed at the landfill)?

17. Adakah pekan kita bersih (Do you think that our town is clean)?
18. Kalau lebih banyak kawasan diberi perkhidmatan pungutan sampah, dapatkah anda menanganinya (If more areas are being provided with scavenging services, do you think that you can cope with it)?

19. Pernahkah truck mengalami kerosakan, dan berapa kerap (Has the truck ever broke down, and how often)?

20. Bagaimana anda membuat kerja kalau truck rosak (How do you do your job when the truck broke down)?

21. Berapa usia truck tersebut (How old is the truck)?

22. Adakah truck cukup besar untuk kerja mengutip sampah (Is the truck big enough for solid waste disposal)?

D. Pendapat Anda (Your Opinion)

1. Apa pendapat anda jenis tong sampah yang sesuai untuk tempat berikut (What do you think of the suitable type of bins for the following places):

a. Pekan (Bazaar)
b. Kampung (Villages)
c. Kuarters kerajaan (Government quarters)
d. Sekolah (schools)
e. Pejabat kerajaan (Government offices)
f. Tempat awam (Public places)

2. Pada pendapat anda bagaimana mengurus sampah berikut (In your opinion how should the following waste be managed)
   a. sisa makanan (kitchen waste)
   b. kertas (paper)
c. besi buruk (scrap iron)
d. kain buruk (old textile)
e. sampah dari kedai (commercial waste)
   f. kaca (glass)

3. Pada pendapat anda adakah cara berikut baik untuk menjaga kebersihan pekan (In your opinion are the following the best way to keep the town clean)?

a. sedia banyak tong sampah (provide enough bins)
b. gotong royong bersih pekan (town cleaning working party)
c. denda kepada yang buang sampah merata (fine for those who discard rubbish indiscriminately)

4. Adakah cara berikut sesuai untuk mengurus tempat pembuangan sampah (Are the following ways suitable for landfill)?

a. pembakaran terbuka (open burning)
b. timbus dengan tanah/pasir (covered with soil/sand)
c. sampah dibiar (rubbish left as it is)
d. guna bahan kimia untuk menghancurkan sampah (use chemicals to decompose waste)

5. Apa pendapat anda jika sampah dipungut cara berikut (What do you think if solid waste is collected in the following manner)?

a. pemunya bawa sendiri sampah ke pusat kutipan (householders bring over the waste to collection station)

b. sediakan pusat kutipan sampah (provide a centralised collecting station)

c. penduduk kampung urus sendiri sampah untuk pusat kutipan (the villagers manage their own waste to be sent to the collecting station)

d. majlis pungut sampah dari pintu ke pintu (the council collect waste from door to door)

6. Adakah sesuai untuk sampah diurus cara berikut pada masa sekarang (Presently, is it suitable for waste to be managed as such)

a. kitar semula (recycle)

b. guna semula (reuse)

c. pengurangan sampah oleh pemunya (waste reduction by households)

d. guna alat pembakar (use of incinerator)

e. buang ke tempat pembuangan sampah (disposal at landfill)

7. Apa pendapat anda jika kutipan sampah dilakukan pada masa berikut (What do you think if waste collection is done during this time):

a. 4.00 - 8.00 malam/night

b. 6.00 - 10.00 malam/night

c. 7.00 - 11.00 malam/night

d. 8.00 - 12.00 malam/night

E. Cadangan Anda (Your suggestion)

Apakah cadangan anda berhubung dengan (What are your suggestions pertaining to):

1. Cara dan masa kutipan sampah (the methods and time of waste collection)
2. Cara pengurusan sampah yang berkesan (the most effective way to manage solid waste)
3. Cara terbaik untuk membersih pekan (the best way to clean the town)
4. Tempat terbaik untuk meletak tong sampah (the best place to put the bins)
5. Cara terbaik untuk mengurangkan sampah (the best way to reduce waste)
6. Cara terbaik untuk mengurus tempat pembuangan sampah (the best way to manage landfill)
7. Cara terbaik untuk menjalankan kerja - kerja mengurus sampah (the best way to manage solid)

Suggestions from Packers.

This part is not included in this interview structure, but are requested by the packers to be discussed with the top management.

8. The general public must be informed of solid waste collection time according to the day, time and zone (locality).
9. There must be public discussion (assembly) to inform the general public on solid waste management.
10. The packers must be issued with 2 pairs each of shirt, trousers, shoes, gloves, and mouth-piece.
11. The packers must go for medical check every month.

Note: This interview was conducted on group basis on the 17.2.1998 at 2.00 pm at Lundu District Council.

Appendix C (1)

Summary of the Interview on the Packers at Lundu District Council Office

Date: 17 February 1998
Time: 2.00 - 4.15 pm

QUESTIONS	ANSWERS
1. Time spend on job	5.00 to 11.00 am in Lundu & 6.00-12.00pm in Sematan
2. Number of working days	7 days a week including Sunday and Public Holiday
3. Number of bins collected per day	288 bins at Lundu town About 100 bins at Sematan town
4. Content of bins	Plastic bottles, paper, kitchen wastes, wood. Sometimes unwanted fans, stove and others.
5. Condition of bins	Bins supplied by Council are good. Bins owned by householders are easily broken.
6. Distance between bins	Between 12 feet to more than 100 feet.
7. Which areas have most wastes?	Bazaar, Secondary School, and road junctions.
8. Do your trucks have lifting devices?	Council used rear-loaders with lifting devices.
9. Any public complaints?	Public complained if their garbage were not collected on time.
10.How do you discard the waste	At landfills which is

	approximately 6 km from Lundu town. One at Sematan which is approximately 8 km from town.
11.Any rivers or dwelling near the landfills?	Lundu- Muslim cemetery and Kampung Stunggang Sematan - Kampung Sebat Melayu & Dayak.
12.Volume of wastes sent to the landfill everyday.	Approximately 4 tons for Lundu town & 3 tons for Sematan town.
13.Are the towns clean.?	The drains, markets, backlanes of shops, bus terminals are dirty.
14.If more areas covered with this service.	Need more workers and trucks.
15.Your preferred bins.	HDPE wheeled-types. Strong and durable.
16.How to manage these types of solid wastes?	
<u>Household waste</u>	Must be placed in plastic bags before throwing into the bins
<u>Commercial waste</u>	The Council should have a program for it. Maybe recycling.
17.How to keep the towns clean?	a) Provide more bins. b) Get the public to participate actively.
18.How best to manage landfill?	a) No burning. b) Solid waste to be covered with soils immediately after disposal.
19.How should solid waste be collected?	a) Householders bring their garbage to collection centers. b) Householders should

	manage their own garbage with Council assistance. c) Council should only collect waste at government premises.
20. Where should bins be placed?	At roadsides. This would enable easy movement of the bins.

Appendix D

Types of Bins Used by Lundu District Council in 1997

No.	Types of bins	Lundu	Sematan	Total
1.	Bulk Mobile garbage bin (1100 litres)	7 units	-	7 units
2.	Bulk Mobile garbage bin (660 litres)	8 units	4 units	12 units
3	2-Wheeled bin (240 litres)	16 units	10 units	26 units
4	2-Wheeled bin (120 litres)	13 units	18 units	31 units
5	Randy litter bin (180 litres)	16 units	1 unit	17 units
6	Other plastic bins (80 litres)	516 units	163 units	679 units
	TOTAL :	576 units	196 units	772 units

Source : Lundu District Council

Note : Item no. 6 was based on counts made by packers. These bins were not supplied by the Council.

Appendix E

No. of bins distributed to selected locations at Lundu town area

Types of bins	Bin capacity	Distribution	Amount (RM)	Given
Bulk Mobile Garbage bin	1,100 litres	Town centre	11,3500.00	5 units
		SRK Bumiputera	2,270.00	1 unit
		Kpg Seling	2,270.00	1 unit
Bulk Mobile Garnage bin	660 litres	Town centre	5,863.00	5 units
		Ferry points	650.00	1 unit
		Kpg Sileng	1300.00	2 units
2-Wheeled bin	240 litres	SRK Bumiputera	1,600.00	5 units
		SMK Lundu	640.00	2 units
		Kpg Sileng	320.00	1 unit
		Jalan Melintang	640.00	2 units
		Hospital	640.00	2 units
		Town centre	1,280.00	4 units
2-Wheeled bin	120 litres	Kpg Sileng	480.00	2 units
		LDC Quarters	1,440.00	6 units
		Ferry point	480.00	2 units
		District Office	480.00	2 units
		Tadika KEMAS	240.00	1 unit
Randy litter bin	180.00 litres	Bus shed (Sekambal)	744.00	3 units
		Bus terminal	992.00	4 units
		Gov't resthouse	744.00	3 units
		Hawker centre	496.00	2 units
		Mini Stadium	992.00	4 units
		Total :	35,911.00	60 units

Source: Lundu District Council

Appendix F

No. of bins distributed to selected locations at Sematan town area

Types of bins	Bin capacity	Distribution	Amount (RM)	Given
Bulk Mobile Garbage bin	660 litres	Town centre	4,563.00	3 units
		Kpg Pueh	1,521.00	1 unit
2-Wheeled bin	240 litres	Town centre	640.00	2 units
		Kpg Pueh	1,920.00	6 units
		Kpg Sebat Dayak	640.00	2 units
2-Wheeled bin	120 litres	Kpg Pueh	1,920.00	8 units
		Kpg Sebat Dayak	960.00	4 units
		Town centre	1,200.00	5 units
		LDC barrack	240.00	1 unit
Randy litter bin	180 litres	Kpg Sebat Dayak	248.00	1 unit
		Total :	13,852.00	33 units

Source: Lundu District Council

Appendix G

Solid Waste Schedule for Lundu Town 1997

	Name of locations	No of houses	Collection schedule
1	SMK Lundu- Quarters	12	Mon.Wed.Fri
	Hostel	5	Mon. Wed. Fri
	Kitchen	1	Everyday
2	Gading National Park	10	Everyday
3	Gading Pump House	6	Mon.Wed.Fri
4	LDC Quarters	10	Mon.Wed.Fri
5	Kpg Sileng Ulu	19	Tues.Thurs.Sat
6	Junction Kpg Sileng	11	Everyday
7	Jalan Melintang	17	Tues.Thurs.Sat
8	Town Zone	24	Tues.Thurs.Sat
9	Bazaar	60	Everyday
10	Jalan Sekambal	7	Tues.Thurs.Sat
11	Taman Jaya	10	Tues.Thurs.Sat
12	Kpg Sungai Lundu	9	Tues.Thurs.Sat
13	Federal Quarters	36	Tues.Thurs.Sat
14	State Quarters	58	Tues.Thurs.Sat
15	Jalan Kedaong	8	Tues.Thurs.Sat
16	Police Station	12	Tues.Thurs.Sat
17	Kpg Pulo Ayer	4	Mon.Wed.Fri
18	Hospital	1	Everyday
19	Federal Offices	13	Mon.Wed.Fri
20	SRK Bumiputera	10	Mon.Wed.Fri
21	SRB Chung Hua	3	Mon.Wed.Fri
22	State Offices	19	Mon.Wed.Fri
23	Ferry points	4	Everyday
24	Town centres- Gerai	1	Everyday
	Stalls	3	Everyday
	Hawker centre	1	Everyday
	Total:	373	

Source: Lundu District Council

Appendix H

Solid Waste Schedule for Sematan Town 1997

	Name of locations	No of houses	Collection Schedule
1	SMK Sematan-Quarters	19	Mon.Wed.Fri
	Hostel	4	Mon.Wed.Fri
	Kitchen	1	Everyday
2	Army Camp	1	Everyday
3	SRK Sematan	3	Mon.Wed.Fri
4	Stalls & markets	3	Everyday
5	SRB Chung Hua	1	Mon.Wed.Fri
6	SRK Sebat Melayu	1	Tues.Thurs.Sat
7	SRK Pueh	1	Tues.Thurs.Sat
8	Shophouses & residential lots	73	Mon.Wed.Fri
9	LDC library & quarters	2	Mon.Wed.Fri
10	Gov't Health Clinic	6	Mon.Wed.Fri
11	Police Station & barrack	4	Mon.Wed.Fri
12	Fisheries Office & barrack	5	Mon.Wed.Fri
13	Telecom & SESCO	8	Tues.Thurs.Sat
14	Pueh Youth Camp	12	Tues.Thurs.Sat
15	Kpg Pueh	21	Tues.Thurs.Sat
16	Kpg Sebat Dayak	11	Tues.Thurs.Sat
17	District Office & Quarters	6	Mon.Wed.Fri
	Total:	184	

Source: Lundu District Council

Appendix I

Landfill Management at Lundu and Sematan Towns

NO	Parameter	LUNDU	SEMATAN
1	Size	9.43 acres	6.91 acres
2	Locality	Kpg Stunggang	Kpg Sebat Dayak
3	Operational date	1991	1997
4	Expected life span	13 years	10 years
5	Vol.of waste/day	4 tons	3 tons
6	Nature of waste	plastic bottles, paper,tin,wood,old tyres,domestic wastes	plastic, bottles,paper, allu.cans,domestic waste
7	Management method	controlled tipping twice a week	controlled tipping once in two weeks
8	Nearby dwellings	Kpg Stunggang	Kpg Sebat Dayak
9	Fencing	none	none
10	Stop-Gate	yes	yes
11	EIA study	none	done 1994
12	Road condition	gravel	gravel
13	Scavengers	dogs/human	dogs/human
14	Leachate discharge	no mitigating measures	pond
15	Gas production	no mitigating measures	no mitigating measures
16	Odour emission	filthy smell	filthy smell
17	Vector habitat	flies pesticide spraying	flies pesticide spraying
18	Site safety	no safety measures	no safety measures
19	Social implications	To close to human dwellings	To close to human dwellings
20	Earth filling	Once a week	Once in two weeks
21	Open burning	None	None

Source: Lundu District Council
Note: Site visits were made by researcher on 16-18 February 1998.

Appendix J

Proposed Solid Waste Program for 1998

No	Locations	No.of houses	Amount (RM)	Justifications
1.	Kpg Dagang	23	1,300.00	New area
2.	Kpg Sungai Lundu	70	2,600.00	Extension
3.	Jalan Kedaong	10	525.00	
4.	Kpg. Seketi	53	1,300.00	Extension
5.	Lundu Shops	60		Improvement
6.	Jalan Blacksmith/ Residential lots	31	1,300.00	
7.	Jalan Melintang	26	1,300.00	
8.	Jalan Sekambal	11		
9.	Kpg Sileng Melayu	124	5,200.00	Extension
10.	Taman Lundu Jaya	25	1,245.00	Extension

Source: Lundu District Council

Appendix K

Revenue on Solid Waste Management

YEAR/ Total (RM.00)	RATEPAYERS (RM .00)	GOVERNMENT CONTRIBUTION (RM .00)	LANDFILL (RM.00)	TRUCK (RM.00)
1995 (30,515)	22,517	7,998	nil	nil
1996 (293,135)	20,696	12,439	80,000	180,000
1997 (80,990)	21,650	9,340	50,000	nil
TOTAL	64,863	29,777	130,000	180,000

Sources:

(1) Annual Financial Statement of Lundu District Council for 1995 and 1996.

(2) For 1997, figures were obtained from the 1998 Estimate on Revenue and Expenditure of Lundu District Council.

(3) Funds for landfill and truck were given to the Council by the State Government in the form of development grant.

Appendix L

Expenditure On Solid Waste Management

YEAR/ Total(RM.00)	LANDFILLS (RM)	REPAIR OF TRUCKS (RM)	WAGES (RM)	HEALTH & BINS (RM)
1995 (125,720)	4,000.00	12,471.00	44,280.00	64,969.00
1996 (284,269)	8,270.00	179,679.00 (purchased of new truck)	46,320.00	50,000.00
1997 (101,271)	5,400.00	11,956.00	49,210.00	34,705.00
TOTAL	17,670.00	204,106.00	139,810.00	149,674.00

Source : Lundu District Council

Note : (1) Item under Wages was inclusive of over-time pay.

(2) Items under Health and Bins were inclusive of health education activities conducted by the Council.

Appendix M

Weight of Solid Waste at Lundu Town in 1998
(as at January 1998)

No	Locality	No.of units served	Approx.weight of waste/day
1	SMK Lundu	18	110 kg
2	Gading National Park	10	82 kg
3	JKR Pump house	6	15 kg
4	LDC Quarters	10	45 kg
5	Kpg Sileng	30	189 kg
6	Jalan Melintang	17	30 kg
7	Town Zone	24	124 kg
8	Bazaar	60	1700 kg
9	Kpg Sebemban	7	35 kg
10	Taman Lundu Jaya	10	60 kg
11	Kpg Sungai Lundu	9	41 kg
12	Federal Quarters	36	135 kg
13	State Quarters	58	188 kg
14	Jalan Kedaong	8	40 kg
15	Police Station	12	65 kg
16	Kpg Pulo Ayer	4	20 kg
17	Hospital	1	82 kg
18	Federal Offices	13	15 kg
19	SRK Bumiputera	10	69 kg
20	SRB Chung Hua	3	7 kg
21	State Offices	19	16 kg
22	Ferry points	4	98 kg
23	Markets/Stalls	6	150 kg
	Total :	373	3316 kg

Note:

(1) The weight of solid wastes were based on random weighing at locations.

(2) The amount of solid wastes collected and discarded everyday were in the range of approximately 3 - 4 tons. Everyday collection involved items no. 2, 8,17, 22 and 23, while other locations were collected three times a week.

Appendix N

Weight of Solid Waste at Sematan Town in 1998
(as at January 1998)

No	Locality	No.of units served	Approx.weight of waste/day
1	SMK Sematan	24	69 kg
2	Army Camp	1	82 kg
3	Markets/Stalls	3	137 kg
4	SRK Sematan	3	11 kg
5	SRB Chung Hua	1	11 kg
6	SRK Sebat	1	11 kg
7	SRK Pueh	2	7 kg
8	Shophouses & residential lots	73	365 kg
9	LDC Quarters & Office	3	7 kg
10	Gov't Health Clinic	6	11 kg
11	Police Station	4	15 kg
12	Fishery Dept & Quarters	5	19 kg
13	Telecom & SESCO	8	21 kg
14	Pueh Youth camp	12	69 kg
15	Kpg Pueh	21	191 kg
16	Kpg Sebat Dayak	11	71 kg
17	District Office & Quarters	6	30 kg
	Total :	184	1127 kg

Note:

(1) The weight of solid wastes were based on random weighing at locations. The amount of solid waste increased during Sunday and Public Holidays as the scavenging services were not done.

(2) Solid wastes collected and discarded everyday were in the range of approximately 1.5- 3 ton. Everyday collection involved items no. 2 and 3, while other locations were collected three times a week.

Appendix O

Types of solid wastes generated by households at Lundu and Sematan 1998
(as at Jan. 1998)

Solid Waste	Localities at Lundu	No.of houses (served with scavenging services only)	Localities at Sematan	No.of houses (served with scavenging services only)
Kitchen waste *	All locations except 18 and 21	343	All locations	184
Paper **	1,8,17,18,19,20, and 21	124	1,4,5,6,7,8,11, 14 and 17	126
Cardboard & Paperboard	Mostly at 8	60	Mostly at 8	30
Plastic	All locations	373	All locations	184
Textiles	5,6,7,8,9,10,11, 12,13,14, and 16	263	8,15 and 16	105
Rubber	Not found	None	Not found	None
Leather	Not found	None	Not found	None
Garden waste	Not found	None	15 and 16	32
Wood ***	6 and 8	77	Mostly at 8	30
Nonferrous metal	Not found	None	Not found	None
Ferrous metal	Mostly at 8	60	Mostly at 8	30
Vehicle parts	Mostly at 8	4	Not found	Not found
Hazardous/ Hospital waste	At 17	1	At 10	1

* only food waste
** all types of paper
*** includes all types of wood products

Appendix P

Proposed Solid Waste collection system and route for Lundu 1998

No	Locality	Units served	Collection system	Route
1	SMK Lundu	18	CCS	A
2	Kampung Sebemban	18	CCS	A
3	Gading National Park	10	DD	A
4	JKR Pump House	6	DD	A
5	Kampung Pulo Ayer	4	CCS	A
6	Sileng Ulu	10	CCS	A
7	Kampung Sileng	144	CCS	A
8	Town Zone	24	DD	A
9	Gov't Offices	30	DD	A
10	Bazaar	60	DD	A&B
11	Markets and stalls	6	CCS	A&B
12	Blacksmith road	31	CCS	A
13	Kampung Dagang	23	CCS	A
14	Kampung Stunggang	178	CCS	A
15	Ferry points	4	CCS	A&B
16	SRK Bumiputera	10	CCS	B
17	Education office	1	DD	B
18	Hospital	1	DD	B
19	State Quarters	58	DD	B
20	District office	1	DD	B
21	Taman Jaya	25	DD	B
22	Melintang road	43	CCS	B
23	LDC Quarters	10	DD	B
24	SRB Chung Hua	3	CCS	B
25	Police Barrack	12	DD	B
26	Kampung Sungai Lundu	79	CCS	B
27	Kedaong road	18	CCS	B
28	Kampung Seketi	53	CCS	B
29	Federal Quarters	36	DD	B
	TOTAL	916		

Note: CCS stands for Centralised Collection Station.
DD stands for Door-to-door collection.

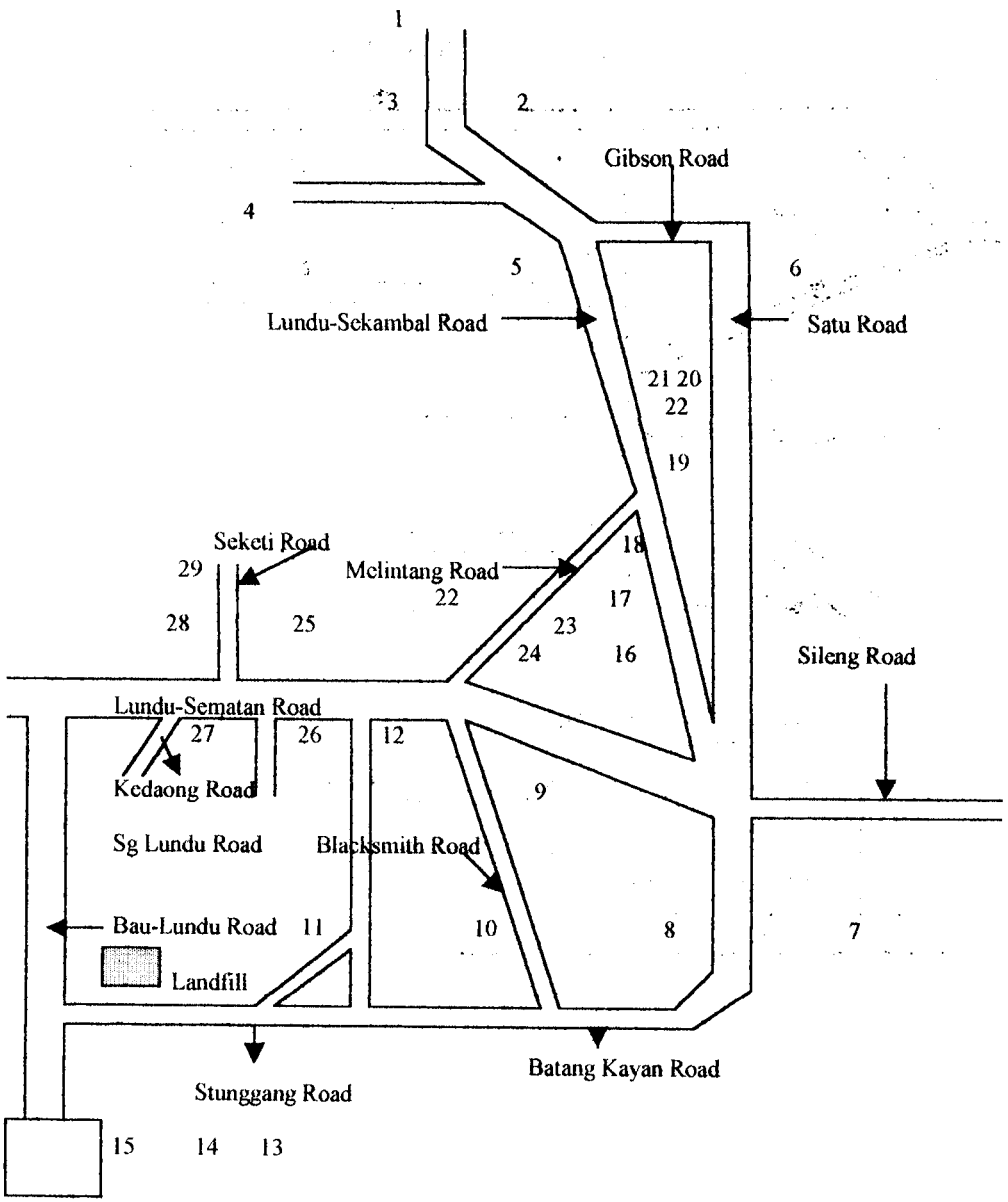
Appendix Q

Proposed solid waste collection system and route for Sematan 1998

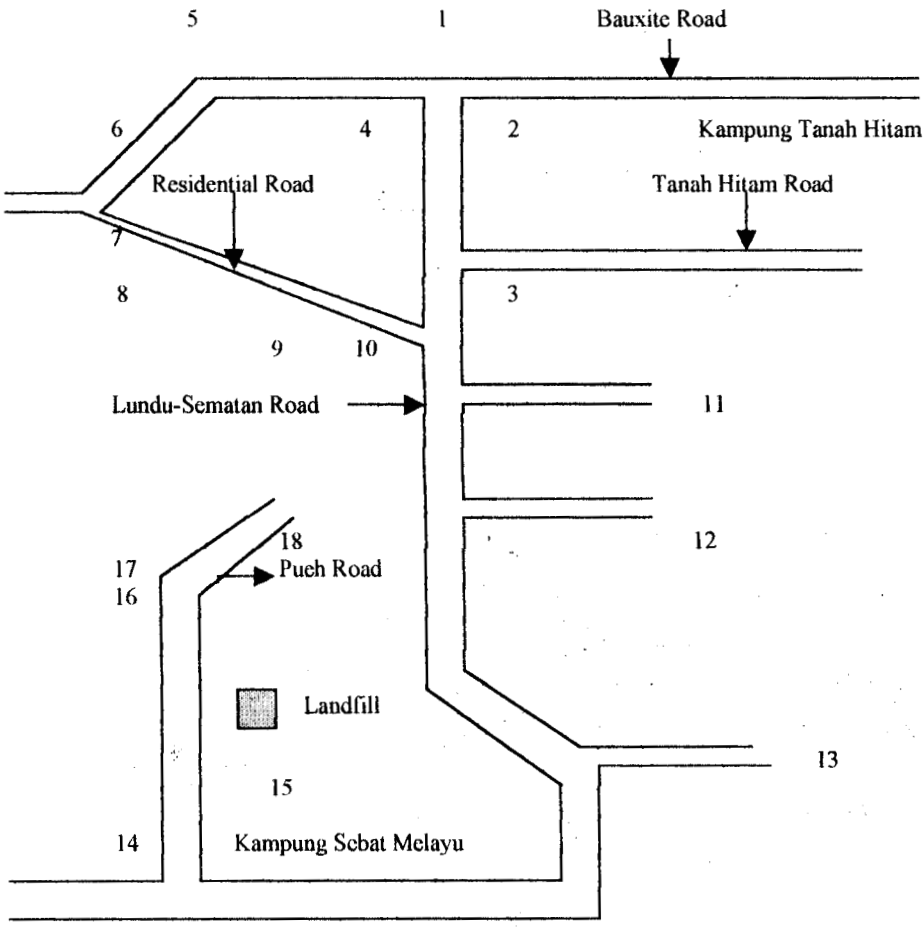
No	Locality	Units served	Collection system	Route
1	Bazaar	30	DD	A&B
2	Residential lots	43	CCS	A
3	SRB Chung Hua	1	DD	A
4	Market and stalls	3	CCS	A&B
5	Army Camp	1	DD	A
6	District office and quarters	6	DD	A
7	Health clinic and quarters	6	DD	A
8	Police Barrack	4	DD	A
9	SRK Sematan	3	DD	A
10	TELECOM	8	DD	A
11	LDC quarters	3	DD	A
12	Fishery dep't quarters	5	DD	A
13	SMK Sematan	24	CCS	A
14	SRK Sebat	1	DD	B
15	Kampung Sebat Dayak	11	CCS	B
16	SRK Pueh	2	DD	B
17	Kampung Pueh	21	CCS	B
18	Pueh Youth Camp	12	CCS	B
	TOTAL	184		

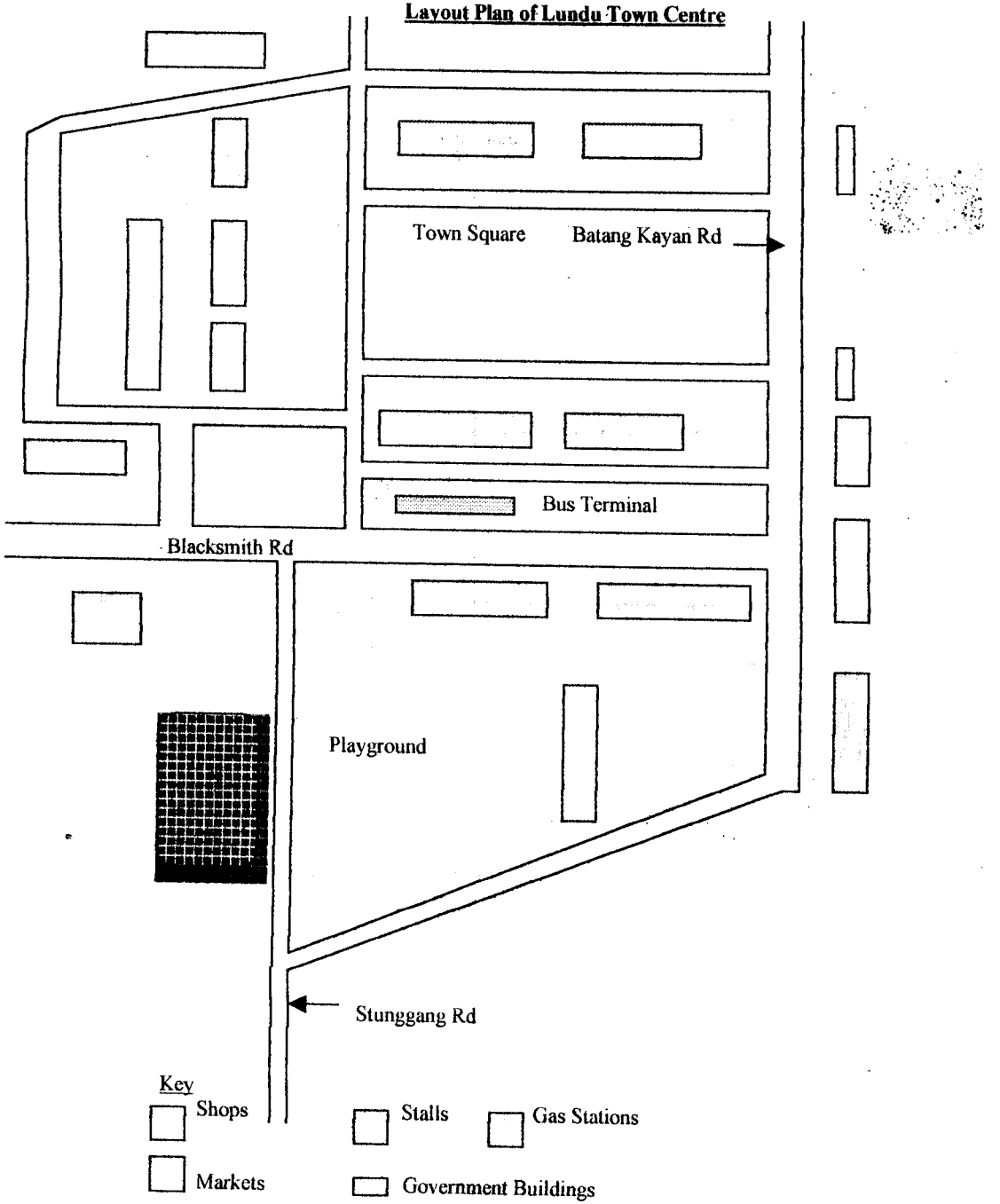
Note: CCS stands for Centralised Collection System.
DD stands for Door-to-door collection.

Sketch Plan of Lundu Town on Solid Waste Route



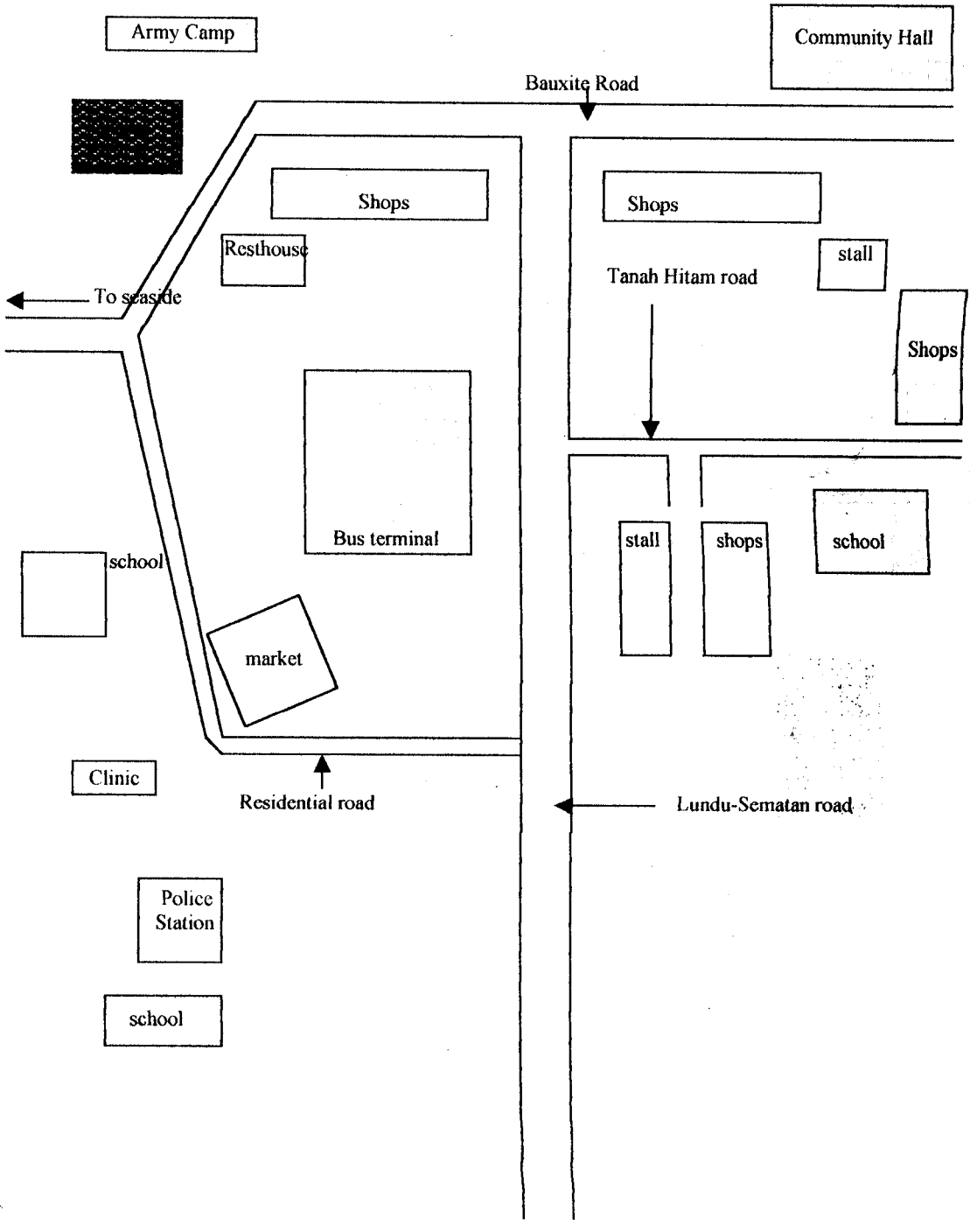
Sketch Plan of Sematan Town on Solid Waste Route




Layout Plan of Lundu Town Centre
Town Square
Batang Kayan Rd
Bus Terminal
Blacksmith Rd
Playground
Stunggang Rd
Key
Shops
Stalls
Gas Stations
Markets
Government Buildings

Appendix U

Layout Plan of Sematan Town Centre



Appendix V

Summary of Evaluators' Reports

Name of Evaluators	Condition of both towns	Landfill Management	General comments on both towns	Solid waste management proposals
Mohamad Zen Masli	Dirty	Roads to landfill should be sealed.	After any festivals, rubbish were found at all over the towns.	LDC and Medical Department should initiate public awareness campaigns.
Aris Hipni	Quiet dirty especially the nearby villages and residential areas.	Agreed with the findings of the researcher.	Agreed that the following places were dirty; 1. bus terminal 2. markets and stalls 3. Residential areas. 4. Nearby villages	Proposed that; 1. Village Development Committee to be given courses on landscaping. 2. To hold cleanliness and beautification competition. 3. Every village to have a mini dumping ground.
Rasdan Hazemi	Dirty	Agreed with findings of the group	Both towns were dirty	Allocate sufficient bins and regular wast collection

Appendix W

Comments of the Action Research Group Members on Action Research

No.	Name of Action Research Group Members	Comments
1	Mr. Jitien ak Ritop	Through Action Research, problems affecting the council in terms of solid waste management could be solved easily. The brainstorming session enabled the group to identify action plan in dealing with poor management of the solid waste.
2	Mr. Segar ak Kallang	During the brainstorming session of the action research group, new ideas, technology and knowledge were made known to the members. It was a useful tool for future planning on proper solid waste management.
3	Mr. Anis bin Abdullah	The group managed to agree to implement the centralised collection system at Kampung Stunggang Melayu. This was done after a long debate over the matter. Given the fact that the group work as a team, this was possible.
4	Mr. Goh Loi Ku	The group managed to come up with new ideas on ways to increase rates through the implementation of the centralised collection system.
5	Mr. Ibrahim bin Suni	The idea of extending scavenging services to Kampung Stunggang Melayu was voiced two years ago in the Full Council Meeting. Nothing came out. Through this group, this was not difficult to implement provided there was teamwork in an organisation.
6	Mr. Bujang bin Budin	Doing research alone was difficult. In action research, the group provided the support and encouragement to me. The brainstorming session was the best place to gather new information, ideas and practices that were applicable in this study. Action Research was indeed a powerful tool in solving problems faced by any organisation.