GOOD GOVERNANCE IN NATIONAL SOLID WASTE MANAGEMENT POLICY (NSWMP) IMPLEMENTATION: A CASE STUDY IN KUALA LUMPUR

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A thesis submitted in
fulfilment of the requirement for the award of the
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DEDICATION

I would like to dedicate this thesis to

ALMIGHTY GOD “ALLAH S.W.T”
(Who gave me strength, knowledge, patience and wisdom)

MY PARENTS “ABAS YUSOF & SALMAH POSO”
(Their pure love, devotion, cares and prayers had helped me to attain my target)

MY LOVELY WIFE & DAUGHTER “ZAMRIAH & ARISSA”
(Their love, care, encouragement and motivation made me to accomplish this valuable work)
This study would not have been possible without the support of many people. I would like to express my sincere thanks and cordial appreciation to my supervisor Assoc. Prof. Dr. Seow Ta Wee. He is the one who had pulled me through the uncertainty of this study and had given his precious time and energy for my study. Without his help, it will be impossible for me to complete this research.

My appreciation also goes to En. Azmy bin Mohd Ali (Deputy Director Department of National Solid Waste Management), Hajah Halizah binti Gumri (Director of Solid Waste Corporation Kuala Lumpur), and En. Azman Shawal (Manager of Corporate Communication) from Alam Flora Sdn Bhd for allowing my presence to their organisation. The information provided from their organisation was very significant and useful in this study. I also cannot forget the member of Malaysian Environmental NGOs (MENGOs) for the cooperation and participation given throughout the study.

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ABSTRACT

National Solid Waste Management Policy (NSWMP) has been introduced as main guideline in Malaysia’s solid waste management. The execution of NSWMP has involves diverse stakeholders which the practice of good governance is a significant requirement to attain the aims of NSWMP. However, the implementation of NSWMP is ineffective because of poor governance. Therefore, this study is conducted to explore the governance of NSWMP in Kuala Lumpur. This research has four (4) research objectives which are to identify the perception of stakeholders in NSWMP governance, to analyse the practices of good governance that implemented by stakeholders, to investigate the constraints of good governance and to develop a good governance framework for effective NSWMP implementation. A convergent parallel strategy is adopted in this study to gather both quantitative and qualitative data in concurrently and to analyse both data separately. A total of 640 respondents were selected through quota sampling method to participate in the quantitative data collection (questionnaire distribution). Besides that, six (6) respondents were selected through purposive sampling method for qualitative data collection (in-depth interview). Descriptive and inferential data analyses were conducted to interpret the quantitative data by using Statistical Package for the Social Sciences (SPSS). Content analysis was adopted to interpret the qualitative data by using NVivo Software. After that, triangulation technique was conducted to develop a good governance framework for NSWMP implementation. In general, the perception of stakeholders on NSWMP governance which based on four main variables (policy clarity, resources management, stakeholder’s competency, implementation system) was moderate. Moreover, this study has found out that the practice of good governance is not a new practice by stakeholders. However, these practices are still insufficient. Accordingly, five (5) constraints of good governance have been identified such as inadequate fund, bureaucratic burden, poor staff competency, poor communication among stakeholders and lack of policy implementation guideline. To address the poor governance issue, this study has developed a good governance framework for effective NSWMP implementation. This framework can improve the decision-making process in NSWMP implementation. Besides that, this framework also enables to enhance the understanding of government and corporate agencies on good governance practice in NSWMP implementation. Basically, this study has given empirical evidence that the good governance theory is applicable for effective NSWMP implementation in Malaysia.
ABSTRAK


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LIST OF ABBREVIATIONS

NSWMP - National Solid Waste Management Policy
DNSWM - Department of National Solid Waste Management
SWCorp HQ - Solid Waste Corporation Headquarters
SWCorp KL - Solid Waste Corporation Kuala Lumpur
UNEP - United Nations Environment Programme
OECD - Organisation for Economic Co-operation and Development
PAHO - Pan American Health Organization
IPCC - Intergovernmental Panel on Climate Change
WCED - World Commission on Environment and Development
DANIDA - Danish International Development Agency
RIC - Regional Implementation Committee
SLC - Service Level Committee
KPI - Key Performance Index
NGO - Non-Governmental Organisation
MSW - Municipal Solid Waste
MSWM - Municipal Solid Waste Management
ISWM - Integrated Solid Waste Management
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<td>Any substances or scarp materials where the holder discards or intends to discard</td>
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<td><strong>Public Policy</strong></td>
<td>A guideline for the process and action of government in decision making to overcome the public problem</td>
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<td><strong>Governance</strong></td>
<td>The way in which power is exercised in the process of decision-making for development</td>
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<td><strong>Good Governance</strong></td>
<td>Ability to manage the resources effectively and solve the conflict in decision making</td>
</tr>
<tr>
<td><strong>Poor Governance</strong></td>
<td>Inability to manage the resources effectively and solve the conflict in decision making</td>
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<tr>
<td><strong>Stakeholder</strong></td>
<td>A people or group of people with responsibility to respond, negotiate, and change the strategy and decision of the organisation</td>
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</table>
**CHAPTER 1**

**INTRODUCTION**

1.1 Introduction

From the past few years, good governance is one of the captivating concepts that was mostly discussed in public administration. Good governance has represented the modes of governing that involves a multiplicity of informal actors and formal institutions in decision-making (Budd et al., 2006). This new mode of interaction has involved a network of government sectors, non-profit organisations, non-governmental organisations (NGO) and other non-state. Poor governance is characterised by unreasonable policy making, unaccountable bureaucracies and unenforced legal systems which can put organisations at risk of failure (Andrew, 2008).

In accordance with this study, this good governance is used to address the issue of poor governance in solid waste policy implementation. Nowadays, efficient solid waste management in urban area is very crucial. Ineffectiveness of solid waste management would cause huge obstacle on social development, environmental vitality and economic stability (Marshall & Farahbakhsh, 2013). Rapid increment of solid waste generated over years in urban area has brought a massive challenge to the government. A progressive solid waste management policy is necessary to cope with this issue. In Malaysia, National Solid Waste Management Policy (NSWMP) has
been introduced in 2007 under Solid Waste Management and Public Cleansing Management Act (Act 672) through Ninth Malaysia Plan (9MP).

The aim of NSWM is to establish integrated solid waste management which based on solid waste hierarchy system (Reduce, Reuse and Recycling) (Sreenivasan et al., 2012). Enactment of Act 672 and development of NSWMP have brought Malaysia’s solid waste management legislation to the worldwide level. However, a typical solid waste management in developing countries including Malaysia display an array of problems. One of the problems that need to be taken into account is the poor governance of solid waste policy (Bjerkly, 2013; Marshall & Farahbakhsh, 2013; Mutalib, 2013).

The governance of solid waste management policy implementation has continues to be more complicated and challenging as the urbanisation keep growing (Manaf et al., 2009). Besides that, the transformation of solid waste management has brought a huge responsibility to stakeholders in Malaysia. Therefore, there are governance issues that have been emerged in NSWMP implementation (Nadzri & Larsen, 2012). Good governance is one of the most captivating concepts that have potential to cope with the poor governance issue in policy implementation (Read, 1999; Andrew, 2008; Bjerkli, 2013). Good governance concept in policy implementation emphasised the aim of policy, promote integrity, and good values among stakeholders, transparent and accountability in decision-making, and enhance stakeholder’s competency. Moreover, stakeholder’s participation is very crucial to practice good governance concept in policy implementation (World Bank, 1995).

Therefore, this study will use good governance concept to investigate the governance of NSWMP implementation. This concept also will help to explain the issue of poor governance and it helps to enhance the governance practice by stakeholders in NSWMP implementation. Towards the end, the aim of this study is to develop a good governance framework for NSWMP implementation. This framework could be an insight for Malaysia towards sustainable solid waste management.
1.2 Background Study

The phenomenon of urbanisation has dragged half the world's population to live in urban areas. According to the United Nations Human Settlements Programme (2008), almost the entire surface of the earth will be dominated by the city in the middle of this century. Moreover, the proportion of Asian living in cities will rise from 35 percent (%) to 53 percent (%) between the year 2000 and 2030 (Cohen, 2004).

Based on the report by the Department of Statistics, Malaysia (2010) Kuala Lumpur has shown the highest urbanisation rate from the year 2000 until 2010. Unfortunately, the rapid urbanisation rate has caused various environmental problems such as climate change, various pollutants, and reduction of raw materials and eradication of biodiversity (Grimmond, 2007; Uttara, Bhuvandas & Aggarwal, 2012). Nowadays, one of the issues that have grabbed the global and local concern is the solid waste management (World Bank, 2012a).

Tremendous population growth is the main contribution towards escalating of solid waste generated in urban area (Zamali et al., 2009). According to the United Nations Environment Programme (2012), the total weight of municipal solid waste at the global level had reached 1.84 billion tons, an increase of 7 percent (%) compared to 2003. Total global weight of municipal solid waste is expected to increase continuously over years. In Malaysia itself, municipal solid waste generated has increased 1.9 percent (%) over years (Agamuthu et al., 2009).

Manaf et al. (2009) has reported, the average solid waste generated in Malaysia is within range 0.5 kg/person/day to 0.8 kg/person/day at rural and small town, whiles average of solid waste generated at urban area is around 1.9 kg/person/day. Kuala Lumpur has been recorded the highest weight of municipal solid waste generated since 1970 until 2002. This estimated weight of municipal solid waste generated would keep increasing, as the urbanisation process continuous.

To address this problem, Malaysian Government has comes up with several strategies and plans toward effective solid waste management. Effective solid waste management practices need to be updated to suit the current waste quantity and
composition (Manaf et al., 2009). Reflecting from that, solid waste management in Malaysia has been addressed comprehensively in Ninth Malaysia Plan.

Transformation of Malaysia’s solid waste management has arisen in 2007. Malaysia has experienced a transformation of solid waste management in term of institutional and policy development (Nadzri & Larsen, 2012). Plenty of programs have been conducted to introduce the solid waste transformation plan to the citizens (Goh, 2007). This transformation has set a goal which to achieve integrated solid waste management throughout Malaysia. The solid waste management transformation process has been embarked through two (2) strategies, which are i) federalising the solid waste management through the enactment and amendment of Acts and regulation, and ii) privatising the collection and transportation of the household’s solid waste (Nadzri & Larsen, 2012).

![Figure 1.1: Concession Companies based on Region in Peninsular of Malaysia (Mutalib, 2013)](image)

Table 1.1 shows the solid waste management related Acts in Malaysia that has been enacted and amended by Malaysian Government. Privatising of solid waste services is regulated to reduce financial pressure on local government (Nadzri & Larsen, 2012). Moreover, privatising process has been conducted through a concession agreement between federal government and three (3) private companies based on the region of states (Figure 1.1).
Table 1.1: Solid Waste Management Related Act in Malaysia
(Department of National Solid Waste Management, 2014)

<table>
<thead>
<tr>
<th>List of Solid Waste Management Legislation</th>
<th>Acts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste and Public Cleansing Management Act</td>
<td>Act 672</td>
</tr>
<tr>
<td>Solid Waste and Public Cleansing Management Corporation Act</td>
<td>Act 673</td>
</tr>
<tr>
<td>Local Government Act (Amended)</td>
<td>Act A1311</td>
</tr>
<tr>
<td>Street, Drainage and Building Act (Amended)</td>
<td>Act A1312</td>
</tr>
<tr>
<td>Town and Country Planning Act (Amended)</td>
<td>Act A1313</td>
</tr>
</tbody>
</table>

This transformation has involved a number of stakeholders. Moreover, stakeholders also have gained huge responsibility to ensure sustainable solid waste management can be achieved (Manaf et al., 2009; Nadzri & Larsen, 2012). Stakeholders in solid waste management are classified into three (3) groups such as primary, secondary and tertiary. Primary stakeholder is refers to the people that responsible for solid waste policy development, enforcement, and implementation. The private sectors such as concession company that participated in the solid waste services either formally or informally is known as secondary stakeholder. Besides that, tertiary stakeholder is waste generator which refers to the people that are compliance with the solid waste regulation (World Bank, 1995; Gugssa, 2012). Hence, each stakeholder has a pivotal role in the governance of solid waste management.

Department of National Solid Waste Management (DNSWM) is one of the primary stakeholders which has established under Solid Waste and Public Cleansing Management Act (Act 672) which gazetted on 30 August 2007. This department is coordinated under the Ministry of Urban Wellbeing, Housing, and Local Government. Act 672 now vests all the legislation related to solid waste management. The uniformity of these Acts is involved throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan.

This Act 672 has given executive authority to the federal government in implementing solid waste management and public cleansing throughout Malaysia. The purpose of this department is to integrate the national solid waste management
system which including collection, transportation, and disposal. As a guide, NSWMP has been formulated under this department. The aims of the NSWMP are:

i) Establish an integrated solid waste management system, which is holistic, cost effective, socially acceptable and sustainable which is emphasizes the environment conservation, affordable technology and securing the public health; and

ii) Implement solid waste management based on solid waste hierarchy which emphasizes waste minimisation through 3Rs (Reduce, Reuse and Recycling), solid waste treatment and final disposal

To clarify further, six (6) objectives have been formulated by the DNSWM such as:

i) A solid waste management that is integrated and cost effective, which includes collection, transportation, intermediate treatment and disposal

ii) Minimisation of solid wastes from the domestic, commercial, industries, institutions community and construction through 3R

iii) Services that are efficient and cost effective through privatisation

iv) Selection of technologies that are proven, affordable in terms of capital expenditure (CAPEX) and operational expenditure (OPEX), and environment friendly technologies

v) Ensure conservation of the environment and public health

vi) Establish institutional and legal framework for solid waste management

(Department of National Solid Waste Management, 2014)

This means that governance of policy implementation is very crucial to achieve effective solid waste management. However, the regulation and policy established is not implemented according to its original plans because of poor governance in NSWMP implementation on the ground. This problem is a significant barrier for Malaysia to strive sustainable solid waste management which has emphasizes three (3) pivotal elements, includes environmental effectiveness, social acceptability, and economic affordability.
1.3 Problem Statement

At present, poor governance has caused ineffective NSWMP implementation in which will brought negative impacts towards environment and human health. Policy is a tool to achieve sustainable solid waste management. Therefore, effective policy implementation on solid waste management is very crucial. Plenty of studies have been conducted regarding the negative impact of ineffective solid waste management to quality of life (Baud et al., 2001; Bernstein, 2004; Cointreau, 2006; Jamshidi et al., 2011; Bjerkli, 2013).

In Malaysia, poor governance has caused the implementation of solid waste policy which was focusing on Reduce, Reuse and Recycling approach seem like feeble and doubtful and not implemented according to its original plan. Based on the report of Solid Waste and Public Cleansing Management Corporation (2014), the recycling rate among Malaysian is still low which is at ±10 percent (%). The low recycling rate among the civilian has caused the increasing of solid waste number that send to landfill year after year (Zamali et al., 2009; Norizan et al., 2011). Based on the 9th Malaysia Plan report, the number of solid waste generated and sent to landfill per day in Peninsular Malaysia has increased 15 percent (%) which is from 16, 200 tonnes per day to 19, 100 tonnes per day between year 2001 until 2005 (Economic Planning Unit, 2006). In 2012, Ministry Urban Wellbeing, Housing and Local Government of Malaysia has recorded the number of waste generated and send to landfill has increased drastically to 33, 000 tonnes per day which is equal with the expected waste generated in 2020 (Manaf et al., 2009). Hence, effective solid waste management policy implementation is significantly required.

In fact, landfilling is the main method of disposal in Malaysia. Mohamad and Keng (2013) has argued 75 percent (%) of the solid waste in Malaysia was directly disposed at landfill, 20 percent (%) of solid waste was burnt and dumped into river and illegal site, and only 5 percent (%) of the solid waste was treated before disposed. Sreenivasan et al. (2012) also has reported only 40% of the solid waste has been disposed properly through recycling, composting, incineration, inert landfill, and sanitary landfill while 60 percent (%) of the solid waste generated are disposed
to the uncompleted landfill which is not equipped with leachate treatment system as well as facilities. This statistic has proven the policy on solid waste management in Malaysia was not implemented effectively. In fact, the adoption of environmentally friendly solid waste management method as emphasized in the National Solid Waste Management Policy has been neglected.

Furthermore, poor governance in solid waste policy implementation has caused the increment of solid waste management cost. Hassan et al. (2001) have found the local government of Malaysia has provided a large amount of financial provision for solid waste management which more than 20 percent (%) of their annual budget. Moreover, Lau (2004) has stated the budget for solid waste collection was ranging from 40 percent (%) to 50 percent (%) of state budget which depend on the size of municipality. Nadzri and Larsen (2012) has also discussed on the average cost of solid waste management in Malaysia which has increased to nearly 70 percent (%) of its yearly budget. The increase of solid waste management cost since 2000 until 2012 has proven the significant correlation between the solid waste management cost and the effectiveness of solid waste policy implementation. Hasnah et al. (2012) has discovered the increasing of the solid waste management cost is due to the ineffective policy implementation on solid waste management. The increase of budget in solid waste management will affect the budget of other services that is also important for the community. Therefore, good governance is crucially required to ensure the national policy of solid waste management is implemented effectively.

Moreover, lack of commitment by stakeholders has caused poor governance practices in NSWMP implementation. Implementation of the NSWMP has extremely demand a huge commitment and responsibility from the government and its stakeholders such as concession companies and local community. However, commitment from stakeholders in NSWMP is poor (Hassan, 1997; Nadzri & Larsen, 2012). Ineffective policy implementation happened in the most developing countries because of poor governance in its management (Lingard et al., 2000; Jones et al., 2011; Nicolli et al., 2012; Fischer & Gottweis, 2012). Most of the solid waste policy that has been enacted in developing countries merely focuses on the technical dimension where management and social dimension has been ignored (Gerlargh et al., 1999; Agamuthu et al., 2009). Therefore, social and management element should be considered during NSWMP implementation.
Involvement of all stakeholders in the process of policies implementation is very crucial to ensure the policy could be implemented effectively on the ground (Ahmed & Ali, 2005). Besides that, there are countries in Asia and Europe has proven the successful of policy implementation by practicing good governance. Integration of social dimension and technical dimension are emphasised in good governance concept (Lingard et al., 2000). Therefore, this study attempts to reveal the governance practices among stakeholders at Kuala Lumpur in NSWMP implementation. Moreover, the stakeholder’s views and perceptions on the existing solid waste management policy are crucial as a guideline to improve the governance of this policy in the future.

1.4 Research Questions

Based on the problem statement, four (4) research questions have emerged which are:

i. What are the perceptions of stakeholders on the governance of NSWMP?

ii. What are the good governance practices implemented by stakeholders in NSWMP implementation?

iii. What are the constraints faced by stakeholders in practising good governance in NSWMP implementation?

iv. How to enhance the good governance practices in NSWMP implementation?

1.5 Objectives

Based on the research questions, four (4) research objectives have been developed which are:

i. To identify the stakeholder’s perception on governance of NSWMP
ii. To analyse the practices of good governance that implemented by stakeholders in NSWMP implementation

iii. To investigate the constraints of good governance practices in NSWMP implementation

iv. To develop a good governance framework for effective NSWMP implementation

1.6 Research Scope

This research only focuses on Kuala Lumpur as a case study. Prior to that reason, the respondents were comprised of stakeholders only from Kuala Lumpur. This study has involved the stakeholders that influence the NSWMP implementation in Kuala Lumpur such as government agencies like Department of National Solid Waste Management (DNSWM) and Solid Waste Corporation Kuala Lumpur (SWCorp KL) and concession company (Alam Flora Sdn Bhd). These stakeholders are responsible to ensure the solid waste policy is successfully implemented and deliver the solid waste management services in Kuala Lumpur. Besides that, stakeholders like NGOs (MENGOs) and local community (Residents of Kuala Lumpur) also have involved in this study because they are the waste generator in Kuala Lumpur. Participation of these stakeholders in this study is very crucial.

In accordance with the subject to be studied, this study only covers the perception of stakeholder on the governance of NSWMP. The perception of stakeholders were measured based on four (4) main variables, namely policy clarity, resources management, stakeholders competency and policy implementation system. After that, the practices of good governance and its constraints in NSWMP implementation were being studied in this study. Moreover, this study only covers two types of instruments to gather the data from respondents such as questionnaire and in-depth interview.

This study has adopted a good governance theory. This theory emphasise fairness in decision making at all level of stakeholders. This theory was adopted to
understand the governance factors that influence the effectiveness of NSWMP implementation. A framework of good governance practices in NSWMP implementation was developed based on this good governance theory and data collected from respondents.

1.7 Organisation of the Thesis

This thesis is arranged and divided into seven (7) chapters. Chapter 1 presents a brief picture regarding this study. It is all about research introduction, background study, problem statement, research questions, research objectives, and research scope and thesis arrangement. In addition, research significant also was discussed in this chapter.

Chapter 2 has included the literature review of the study. It explores several concept related to this study such as the concept of solid waste, concept of stakeholders, concept of public policy and concept of policy implementation. These concepts are discussed deeply to understand the issues related to this study. Moreover, this study emphasise good governance practices in policy implementation. Therefore, this chapter has highlighted the theoretical framework that was developed based on good governance theory to understand the issues and fill the gap of poor governance in policy implementation.

Chapter 3 describes the detail of study area profile and justification of study area selection. Besides that, this chapter also explains the related method that is used for the study. The detail of methodology used covers sampling method, data collection method, and data analysis. Moreover, ethic of research also has been discussed briefly in this chapter.

Chapter 4 and 5 discuss the result of this study. Chapter 4 discussed about perception of stakeholder on the governance of NSWMP. Besides that, Chapter 5 discussed about the practices of good governance and its constraints in NSWMP execution.
Chapter 6 presented the discussion of findings. Besides that, this chapter also discussed about the good governance framework for effective NSWMP implementation which developed based on findings and policy governance model. The last chapter is Chapter 7 which about the discussion on the achievement of research objectives, contribution of research, limitation of research and recommendation for further research.

1.8 Research Significant

The finding from this study is very significant for government agencies such as DNSWM and SWCorp to enhance the governance practices in NSWMP implementation. For example, it would help the policy and planning division to coordinate and review all the issues with regard to policy development more effectively. Moreover, the findings of this study also useful for enforcement and regulation division to monitor all the enforcement activity effectively. Besides that, the finding from this study also is very relevant for government agencies to plan and manage all the activities and programs with regards to the enforcement and implementation of policy.

Furthermore, the data and finding from this study is related with solid waste management policy in Malaysia. Hence, this data is significant for academicians and researchers who are interested in research of solid waste management policy area. The findings from previous researches are possibly different in the context of locality and time. Hence, the finding of this study is significant to enrich the knowledge of solid wastes management policy research. Besides that, the finding from this research is also significant to fill the gap of poor governance in policy implementation. As a result, awareness among private and government staff in good governance practices of policy implementation would be enhanced.
1.9 Chapter Summary

Chapter 1 discussed the introduction and background of the study. Besides that, the issues and research problems have been explained deeply. Resulting to this, several research questions have emerged and several objectives established. Moreover, scopes of this research have been formulated to ensure this study is following the right track and the objectives that have been set up are achievable. Ineffective implementation of solid waste management legislation becomes a huge issue in many countries including Malaysia. A good governance practices through integration of technical and social dimension in policy implementation is an effective strategy.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the literature review related to this study. The previous concepts and studies related with this research were discussed briefly. This chapter extensively discuss the concept of solid waste which including the definition, the issues of solid waste and the rationale of sustainable waste management. In addition, the concept of Integrated Solid Waste Management (ISWM) also discussed as a paradigm towards sustainable solid waste management. After that, the concept of stakeholder in solid waste management was explained to give an overview of the parties that involved in municipal solid waste management. The relationship between public policy and solid waste management policy also discussed to understand the process of policy cycle and the important of policy for solid waste management. Moreover, the concept of policy implementation was reviewed to analyse the factors that influenced the effective governance of policy implementation. Besides that, the idea of good governance theory was analysed in this chapter as an approaches to understand the good governance practices that influence the effectiveness of solid waste policy implementation. Then, the theoretical framework is explained at the end of this chapter as a guide of this study and it provides justification for the choice of research subject.
2.2 The Concept of Solid Waste Management

Solid waste is unwanted things that produced by the human activities. Solid wastes have a mass, weight, and constant volume (Pichtel, 2005). There are several classes of solid waste which are municipal solid wastes, agriculture wastes, construction wastes, electric and electronic wastes (E-waste), and industry wastes (World Bank, 1999a). In fact, this solid waste classification is based on the place where the solid wastes have produced. However, regardless of its origin, whether the solid waste from municipal, agriculture, industrial or commercial, it shows the incomplete usage of natural resources as well as raw material. Hence, it is a financial loss to the world, country and individual itself (Holmes, 1996).

2.2.1 Definition of Solid Waste

There are plentiful definitions for the solid waste constitutes and classification (World Bank, 1999a). In fact, these definitions are attempting to segregate and categories the solid waste material. Most of the countries have defined solid waste by act (Read, 1999). Since early 1989, in the Basel convention, solid waste has been defined as a thing that needs to be disposed or required to be disposed by individual institutional, and industry under the national regulation (World Bank, 1999a). Hence, the definition of solid waste may different in each country.

The definition of solid waste by United Nations Environment Programme (UNEP) in the Agenda 21 is quite similar with most of the countries including Malaysia (United Nations, 1992b). Solid waste is all types of not dangerous domestic waste which derived from commercial, agriculture, household, institutional, construction and civil activities (Read, 1999; Hansen et al., 2002; Pichtel, 2005).

Besides that, the European Union Framework Directive on Waste (91/156/EEC) and Malaysia Act 672 have defined solid waste in a quite similar perspective which is any substances or scarp materials which the holder discards or intends to discard (World Bank, 1999a). The scarp or substances that that no longer
been used or needed are consider as the solid waste. In fact, the dimension of solid waste definition has become complicated reflect the emerging of complex wastes characteristics. In Malaysia, solid wastes are generally categorised into three major groups and each group is under the responsibility of different government department such as Ministry of Housing and Local Government is responsible for municipal solid waste, Department of Environment is responsible for schedule/hazardous waste and Ministry of Health is responsible for clinical waste (Manaf et al., 2009).

2.2.2 Municipal Solid Waste (MSW)

Municipal solid waste is known as the waste that generated within the urban area which is from household, commercial centre, institution, and industry (Ludwig et al., 2003). The solid waste from the municipal is heterogeneous which comprising of various materials such as glass, metal, plastic, paper (Table 2.1).

Municipal solid waste is segregate and categories based on their physical compositions which are organic or inorganic waste (Table 2.2). Organic waste consists of food waste, garden waste, paper waste, and textile and rubber waste. Besides that, inorganic waste consists of plastic waste, metal waste, and glass waste. Moreover, in other perspective, municipal solid waste is defined base on its biodegradable status which fully biodegradable such as some organic waste, paper and textiles, partially degradable like some organic waste, disposable napkin and sanitary waste and non-degradable such as metals, glass and electronic waste (Jha et al., 2011).
Table 2.1: The Sources of Municipal Solid Waste and its Types
(Franklin Association, 1999)

<table>
<thead>
<tr>
<th>Source of Municipal Solid Waste</th>
<th>Type of Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Food waste, food container and packer, can, bottles, papers and newspaper, clothes, garden waste, e-wastes, furniture waste</td>
</tr>
<tr>
<td>Commercial Centre (office lot, small shop, restaurant)</td>
<td>Various type of papers and boxes, food waste, food container and packer, can, bottles,</td>
</tr>
<tr>
<td>Institutional (school, university, college, hospital)</td>
<td>Office waste, food waste, garden waste, furniture waste</td>
</tr>
<tr>
<td>Industry (factory)</td>
<td>Office waste, cafeteria waste, processing waste</td>
</tr>
<tr>
<td>City Centre (drainage and road)</td>
<td>Various type of garden waste, construction waste, public waste</td>
</tr>
</tbody>
</table>

Table 2.2: Physical Composition of Municipal Solid Waste
(Pichtel, 2005)

<table>
<thead>
<tr>
<th>Physical Composition</th>
<th>Basic Classification</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic</td>
<td>Food waste</td>
<td>Vegetables, meats</td>
</tr>
<tr>
<td></td>
<td>Garden waste</td>
<td>Dried leaves, twigs, cut grasses</td>
</tr>
<tr>
<td></td>
<td>Textile and rubber</td>
<td>Clothes, leather products</td>
</tr>
<tr>
<td></td>
<td>Paper and Box</td>
<td>Newspaper, vary type of paper and box products</td>
</tr>
<tr>
<td>Inorganic</td>
<td>Plastic</td>
<td>1 = Polyethylene terephthalate, 2 = High-density polyethylene, 3 = Polyvinyl chloride, 4 = Low-density polyethylene, 5 = Polypropylene, 6 = Polystyrene, 7 = Multilayer Plastic</td>
</tr>
<tr>
<td></td>
<td>Glass</td>
<td>*based on coding plastic system by Plastics Industry Association Incorporation</td>
</tr>
<tr>
<td></td>
<td>Metal</td>
<td>Various type of glass products used in home, laboratory, and etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ferrous products, zinc, chromium, and vary type of metal products</td>
</tr>
</tbody>
</table>
Based on the Organisation for Economic Co-operation and Development (OECD) definition, municipal waste is collected and treated by or for municipalities. It covers waste from households, including bulky waste, similar waste from commerce and trade, office building, institutions and small business, yard garden, street sweeping, content of litter containers and market cleansing (OECD, 2013). Wastes from sewage networks and treatment, as well as municipal construction and demolition is excluded. Besides that, Pan American Health Organization (PAHO) has defined municipal solid waste as solid or semi-solid waste generated in population including domestic and commercial wastes, as well as those originated by the small-scale industries and institutions which including hospital and clinics, market street sweeping and from public cleansing (PAHO, 1998). The Intergovernmental Panel on Climate Change (IPCC) has included the following in MSW such as food waste, garden waste, park waste, paper and cardboard, wood textile, nappies (disposable diapers) rubber and leather, plastics, metal, glass, ash, soil, electronic waste (IPCC, 2006).

2.2.2.1 Municipal Solid Waste Management (MSWM)

As various type of municipal solid waste generated nowadays, the management of these solid wastes become more complicated. System used in municipal solid waste management is depending on the characteristics of the solid waste generated. In fact, the system of municipal solid waste management is quite similar in many countries (Read, 1999). The system has involved a solid waste storage, collection, transportation, treatment and disposal. However, efficacy of the system adopted is different in high income countries and low income countries. Municipal solid waste management in high income countries is looks more effective than the low income countries (World Bank, 1999a). Moreover, the high income countries are continuous to spend most of their SWM budget on disposal. Besides that, the low income countries are continuous to spend most of their SWM budget on solid waste collection rather than disposal (Memon, 2010). The discussion of global and local perspective with regard to municipal solid waste management should give an
overview of current municipal solid waste generation, composition, collection and disposal.

2.2.2.2 Municipal Solid Waste Management: A Global and Local Perspective

Solid waste is inextricably linked to urbanisation and economic development. As the countries urbanised, their economic wealth is increase. As standards of living and disposable incomes increase, consumption of goods and services increase, which results in a corresponding increase in the amount of waste generated in urban area.

Solid waste management is the responsible of the local authorities in most of the countries. The main objective of municipal solid waste management is to take care of the wastes generated in the most economically, socially and environmentally optimal condition. However, this objective seems difficult to be achieved since plenty of problems have emerged as abundant of solid waste is generated. In fact, solid waste is one of the pernicious local pollutants. Hence, the municipal solid waste management need to deal with integrated aspects.

In general, the municipal solid waste management system in Malaysia is quite similar with the global perspective which involving the storage, collection, transportation, treatment, and disposal (Seow, 2009; World Bank, 2012a). In Malaysia, solid waste management is begins from the storage at household or commercial centre or storage centre within municipal area. After that, is the collection and transportation of solid waste before proceed into treatment phase. Solid wastes that disable to treat were disposed at landfill. In fact, solid waste management system practiced in Malaysia is quite similar to the developed countries. However, efficiency of the solid waste management system is main constraint existed in Malaysia and most of developing countries (Seow, 2012; Jha et. al., 2011).
(a) Solid Waste Generated

The current world municipal solid waste generated levels are approximately 1.3 billion tonnes per year. This figure is estimated increase to approximately 2.2 billion tonnes per year by the year 2025 (World Bank, 2012a). Based on Figure 2.1, waste generated rates are influenced by economic development, the degree of industrialization, public habits and local climate. The rapid economic development and urbanisation has increasing of solid waste generated (Manaf et al., 2009; Tchobanoglous et al., 1993). The high income countries has contributed 46 percent (%) of the world solid waste generated followed with upper middle income countries (29%), lower middle income countries (19%) and lower income countries (6%).

<table>
<thead>
<tr>
<th>Percentage of Waste Generated based on Country Income Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Middle Income</td>
</tr>
<tr>
<td>19%</td>
</tr>
<tr>
<td>Upper Middle Income</td>
</tr>
<tr>
<td>29%</td>
</tr>
<tr>
<td>Lower income</td>
</tr>
<tr>
<td>6%</td>
</tr>
<tr>
<td>High income</td>
</tr>
<tr>
<td>46%</td>
</tr>
</tbody>
</table>

Figure 2.1: Percentage of Waste Generated by Country Income Level (World Bank, 2012a)

Moreover, the rate of waste generated is different by region, country, and cities. For Example, based on Table 2.3, the amount of waste generated per year in East Asian countries is lower (270 million tonnes/year) than European countries (572 million tonnes/year) even the urban population in East Asian countries in much greater with 777 million peoples than European countries with 729 million peoples. The living standards and consumption of goods are increase as urbanisation is continues. As the result, the amount of waste generated is increase year after year.
Table 2.3: Solid Waste Generated based on Region
(World Bank, 2012a)

<table>
<thead>
<tr>
<th>Region</th>
<th>Urban Population (million)</th>
<th>Waste Generated (million tonnes/year)</th>
<th>Waste Generation (kg/person/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>260</td>
<td>62</td>
<td>0.09 – 3.0</td>
</tr>
<tr>
<td>East Asia/Pacific Region</td>
<td>777</td>
<td>270</td>
<td>0.44 – 4.3</td>
</tr>
<tr>
<td>Eastern/Central Asia</td>
<td>227</td>
<td>93</td>
<td>0.29 – 2.1</td>
</tr>
<tr>
<td>Latin America/Caribbean</td>
<td>399</td>
<td>160</td>
<td>0.1 – 1.4</td>
</tr>
<tr>
<td>Middle East/North Africa</td>
<td>162</td>
<td>63</td>
<td>0.16 – 5.7</td>
</tr>
<tr>
<td>European Countries</td>
<td>729</td>
<td>572</td>
<td>1.1 – 3.7</td>
</tr>
<tr>
<td>South Asia</td>
<td>426</td>
<td>70</td>
<td>0.12 – 5.1</td>
</tr>
</tbody>
</table>

The quantity and characteristics of the solid waste generated is very significant in planning of solid waste management (Tchobanoglous et al., 1993). However, most of the studies conducted on waste generated and characteristics are focused on the solid waste collected and disposed at landfill. In the context of Malaysia, documentation of the data regarding municipal solid waste generation is still limited and uncompleted in some area as compared to the European countries (Manaf et al., 2009).

The change in rate and pattern of solid waste generated was influenced by several crucial factors such as demography factors and urban lifestyle (Vergara & Tchobanoglous, 2012). Solid waste generation in Malaysia is estimated about 26 million tons in 2007. The composition of municipal solid waste is 30 percent (%) from the total solid waste generated (Larsen, 2007). Statistics show nearly 50 percent (%) of the municipal solid waste generated in Malaysia is comes from household followed by commercial waste, street cleansing, institutional, industry and construction (Saeed, 2009). Table 2.4 shows the municipal solid waste generation in Malaysia’s city centre since 1970 until 2002. The pattern of municipal solid waste generation at West Peninsular Malaysia City centre is increase dramatically compare to the city centre in the east peninsular Malaysia. This condition shows the urbanisation process is rapidly occur in west peninsular Malaysia as compared to east peninsular Malaysia. Moreover, average of solid waste generated by per person per day in Malaysia is between 0.5 kg to 0.8 kg at rural and small town, whiles average of solid waste generated per person per day at urban area is around 1.9 kg (Manaf et
This figure is estimated to keep increasing as the urbanisation process continuous in Malaysia.

Table 2.4: Municipal Solid Waste Generated in Urban Centres of Peninsular Malaysia
(Agamuthu et al., 2009; Eusuf et al., 2011)

<table>
<thead>
<tr>
<th>Urban Centres</th>
<th>Solid Waste Generated (tons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuala Lumpur</td>
<td>98.9</td>
</tr>
<tr>
<td>Johor Bahru</td>
<td>41.1</td>
</tr>
<tr>
<td>Ipoh</td>
<td>22.5</td>
</tr>
<tr>
<td>Georgetown</td>
<td>53.4</td>
</tr>
<tr>
<td>Klang</td>
<td>18.0</td>
</tr>
<tr>
<td>Kuala Terengganu</td>
<td>8.7</td>
</tr>
<tr>
<td>Kota Bharu</td>
<td>9.1</td>
</tr>
<tr>
<td>Kuantan</td>
<td>7.1</td>
</tr>
<tr>
<td>Seremban</td>
<td>13.4</td>
</tr>
<tr>
<td>Melaka</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Composition of municipal solid waste might be different as well as variable depend on the area. However, organic waste is the main composition which generated nearly 50 percent (%) of the total municipal solid waste followed by plastics, paper, metal and glass. This condition is quite similar as occurring in most of developing countries which the organic waste is the main solid waste composition as compared to the developed countries (World Bank, 1999a). Table 2.5 shows the pattern of municipal solid waste composition generated in Malaysia since 1975 until 2005. The generation of organic wastes is reducing 18.9 percent (%) in 2005 as compared to the year 1975. Besides that, the generation of inorganic waste is increasing in average nearly 7 percent (%) in 2005 which lead by plastics waste followed by paper and glass waste. This change of solid waste composition pattern and characteristics reflects the change of nature lifestyle of the Malaysian population during this period.
Table 2.5: Percentage (%) of the Solid Waste Composition in Malaysia (Agamuthu et al., 2009)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic</td>
<td>Food/garden</td>
<td>63.7%</td>
<td>54.4%</td>
<td>48.3%</td>
<td>48.4%</td>
<td>45.7%</td>
<td>43.2%</td>
<td>44.8%</td>
</tr>
<tr>
<td>Inorganic</td>
<td>Paper</td>
<td>7.0%</td>
<td>8.0%</td>
<td>23.6%</td>
<td>8.9%</td>
<td>9.0%</td>
<td>23.7%</td>
<td>16.0%</td>
</tr>
<tr>
<td></td>
<td>Plastics</td>
<td>2.5%</td>
<td>0.4%</td>
<td>9.4%</td>
<td>3.0%</td>
<td>3.9%</td>
<td>11.2%</td>
<td>15.0%</td>
</tr>
<tr>
<td></td>
<td>Glass</td>
<td>2.5%</td>
<td>0.4%</td>
<td>4.0%</td>
<td>3.0%</td>
<td>3.9%</td>
<td>3.2%</td>
<td>3.0%</td>
</tr>
<tr>
<td></td>
<td>Metal</td>
<td>6.4%</td>
<td>2.2%</td>
<td>5.9%</td>
<td>4.6%</td>
<td>5.1%</td>
<td>4.2%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Others</td>
<td>Others</td>
<td>17.9%</td>
<td>34.6%</td>
<td>8.8%</td>
<td>32.1%</td>
<td>32.4%</td>
<td>14.5%</td>
<td>17.9%</td>
</tr>
</tbody>
</table>

(b) Solid Waste Storage

Waste storage is a first step in municipal solid waste management system which is very crucial to ensure the solid waste collection can be operated effectively (World Bank, 2012a). In fact, the method used in solid waste storage is absolutely influenced by the collection method that practiced (Goh, 2007). In general, there are two types of solid waste storage that practiced at waste generator level which are mixed storage or separated storage. Mixed storage method is operated by keep all type of solid waste in the bins or rubbish bags. Besides that, separated storage method is operated by keep the solid waste based on its types for recycling purpose (Sreenivasan et al., 2012).

In separated wastes storage, the waste generators are required to separate their waste at source into wet waste such as food waste and organic matter and dry waste like recyclables item. In addition, it is possible a third stream of waste which is non-recyclables as well as residues (World Bank, 2012a). In some developed countries like United Stated, the unsegregated solid waste that potential to be recycled could be separated using advanced technology such as Material Recovering Facilities (MRF) (Sreenivasan et al., 2012). In developing countries, solid waste is not separated or sorted before it is taken for disposal. The recyclables are removed by
waste pickers during the collection process and disposal phase at landfill sites (Seow, 2009). In developed countries, solid waste is separated systematically since at waste generators level. However, storage of solid waste practiced is depending on the local regulations (Read, 1999).

Municipal solid waste storage in Malaysia can be divided into two phase. In the first phase, solid waste is stored temporary by the waste generators near its generated point. Usually, the waste is packed using small or medium plastic bag before transfer into big garbage bag. The reused of plastic bag as a temporary garbage bag is not a new phenomenon in Malaysia. It has been practiced for many decades. However, segregation of recyclables is not practiced by Malaysian household (Goh, 2007; Norizan et al., 2012). Most of the household’s waste such as food waste, plastic waste and glass waste is discarded into garbage bags.

In the second phase, the solid waste is kept outside of the houses, premises, offices, or factories until it is collected by the waste collectors (Sreenivasan et al., 2012). Usually, all the wastes are deposited into garbage bins that have been provided or purchased. For the landed property owners, they are compulsory to purchase a suitable waste bin from the local authorities in reasonable price (Goh, 2007). Besides that, properly designed bins are provided for free to premises and residential area like apartment and illegal settlement. However, in some cases, the bins or containers are poor in maintenance which resulting the damage of the bins (Goh, 2007). Some households just leave the garbage bags by the street side because the bins and containers are unusable. Hence, it has given an opportunity to the stray animals like dog and cat to scatter the wastes along the street.

(c) Solid Waste Collection

Municipal solid waste collection is an important aspect to maintain the cleanliness and public health in the cities (Sreenivasan et al., 2012). Hence, collection of municipal solid waste is a crucial element in solid waste management system. The purpose of solid waste collection is to collect the solid waste from point of production such as at
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