

# **PENGURUSAN TAPAK PELUPUSAN MAPAN MELALUI PENDEKATAN KITAR SEMULA DI SABAH**

PERPUSTAKAAN  
UNIVERSITI MALAYSIA SABAH

**ABDUL HAIR BIN BEDDU ASIS**

**FAKULTI KEMANUSIAAN, SENI DAN WARISAN  
UNIVERSITI MALAYSIA SABAH  
2016**

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SABAH**

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UNIVERSITI MALAYSIA SABAH

**TESISINI DISERAHKAN UNTUK MEMENUHI  
SYARAT MEMPEROLEHI IJAZAH DOKTOR  
FALSAFAH**

**FAKULTI KEMANUSIAAN, SENI DAN WARISAN  
UNIVERSITI MALAYSIA SABAH  
2016**



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PENDEKATAN KITAR SEMULA DI SABAH**

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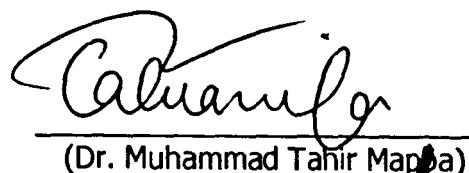
  
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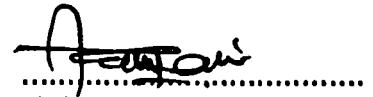


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PA20109030



**PENGESAHAN**

NAMA : **ABDUL HAIR BIN BEDDU ASIS**

NO. MATRIK : **PA20109030**

TAJUK : **PENGURUSAN TAPAK PELUPUSAN MAPAN MELALUI  
PENDEKATAN KITAR SEMULA DI SABAH**

IJAZAH : **IJAZAH SARJANA DOKTOR FALSAFAH (GEOGRAFI)**

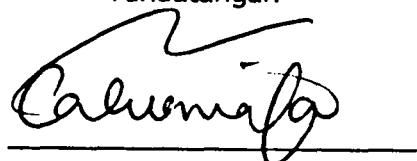
TARIKH VIVA : **14 SEPTEMBER 2016**

**DISAHKAN OLEH;**

**PENYELIA**

Dr. Mohammad Tahir Mapa

Tandatangan



## **PENGHARGAAN**

Pertama-tamanya saya Abdul Hair Bin Beddu Asis, beralamat (Lot 1039, Jambatan 5, Kampung Tinusa 2, batu 7 Jalan Airport, 9000 Sandakan, Sabah) mengucapkan rasa syukur ke hadrat Allah S.W.T kerana dengan limpah dan rahmatnya telah memberikan ruang dan peluang kepada saya untuk menyiapkan kajian peringkat Ijazah Doktor Falsafah (PhD) ini. Selawat dan salam ke atas junjungan besar baginda Muhammad S.A.W atas usaha baginda, saya telah berada dalam akidah yang saya yakini kini.

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Abdul Hair Bin Beddu Asis  
4 Oktober 2016

## ABSTRAK

Masalah pengurusan tapak pelupusan semakin serius di peringkat antarabangsa mahupun peringkat Malaysia. Faktor utama adalah disebabkan oleh pertambahan jumlah penduduk yang berkadar langsung dengan pertambahan sisa. Kemuncak dari itu adalah masalah penutupan tapak pelupusan yang tepu, pencemaran cecair lesapan, pencemaran bau dan masalah penyakit. Oleh itu kajian ini bertujuan untuk mengetengahkan elemen kitar semula dalam konsep pengurusan tapak pelupusan yang lebih mapan di Sabah (Tapak Pelupusan Kayu Madang DBKK, Tapak Pelupusan Sandakan MPS dan Tapak Pelupusan Bukit Gemok MPT). Untuk mencapai tujuan tersebut, komposisi sisa di tapak pelupusan perlu dikenalpasti. Selain itu corak pengurusan tapak pelupusan mapan yang diamalkan turut dikenalpasti. Peranan masyarakat, pihak swasta dan *Scavengers* (pengutip sampah) dalam menyumbang kepada konsep pengurusan tapak pelupusan mapan ditentukan. Sumbangan kitar semula dalam pengurusan tapak pelupusan mapan dan alam sekitar juga dinilai. Terdapat empat kaedah pengumpulan data yang digunakan iaitu kaedah temubual, kaedah soal selidik, pengumpulan data sekunder dan kaedah analisis LCA untuk mengetahui sumbangan kitar semula dalam melestarikan tapak pelupusan khususnya dalam penjimatan tenaga. Tiga jenis analisis digunakan iaitu analisis transkripsi, analisis frekensi (SPSS), analisis data sekunder (ADS) dan analisis Penilaian Kitar Hayat (LCA). Kajian ini mendapati bahawa kaedah kitar semula sebagai cara terpenting dalam menguruskan tapak pelupusan terutama dalam mengurangkan jumlah sisa di tapak pelupusan. Secara umumnya, kajian ini mengetengahkan komponen kitar semula yang perlu ada dalam pengurusan tapak pelupusan iaitu komponen kitar semula isirumah, kitar semula pusat pengumpul dan kitar semula *Scavengers*. Kajian ini turut mendapati terdapat 8 jenis komposisi sisa dikenalpasti di tapak pelupusan DBKK dan MPT dan 9 jenis komposisi sisa di tapak pelupusan MPS. Jumlah purata sisa yang dilupuskan di tapak pelupusan DBKK adalah 13020.29 tan/bulan, tapak pelupusan MPS sebanyak 10611.94 tan/bulan dan tapak pelupusan Bukit Gemok MPT sebanyak 9000 tan/bulan. Ketiga-tiga tapak pelupusan tidak menggunakan sebarang model pengurusan tapak pelupusan mapan dalam operasi tapak pelupusan. Sumbangan isirumah, pusat pengumpul dan *Scavengers* berjaya dalam mengurangkan jumlah sisa ditapak pelupusan masing-masing sebanyak 14.5%/bulan, 11.32%/bulan dan 3.72%/bulan untuk tapak pelupusan DBKK, 3.82%/bulan, 41.2%/bulan dan 0.13%/bulan untuk tapak pelupusan MPS dan 0.74%/bulan, 1.28%/bulan dan 0.38%/bulan untuk tapak pelupusan MPT. Analisis LCA mendapati terdapat penjimatan tenaga dalam penghasilan produk baru dengan menggunakan bahan kitar semula berbanding menggunakan bahan asli. Melalui dapatan ini juga, pengiraan tempoh hayat tapak pelupusan dapat ditentukan berdasarkan jumlah pengurangan sisa di tapak pelupusan.

## **ABSTRACT**

### **SUSTAINABLE LANDFILL MANAGEMENT THROUGH RECYCLING APROACH IN SABAH**

*Landfill management issues are getting serious attention whether in Malaysia or international level. The main factor for this to happen is because population growth is directly proportional to the increase of waste disposal. This situation has brought another alarming issues such the closure of saturated landfill, leachate and odour pollution, and diseases. Therefore, this study aims to highlight the elements of recycling in landfill management that are more sustainable in Sabah (Kayu Madang Landfill of DBKK, Sandakan landfill under MPS and Bukit Gemok landfill under MPT). To achieve this objective, the composition of waste in the landfill should be identified. Besides, well-established pattern of landfill management practices is also evaluated. The role of public, private and scavengers in contributing to the concept of sustainable landfill management are determined. The contribution of recycling in landfill management and environmental sustainability are also evaluated. There are four data collection methods that were used, which are interview, questionnaires, secondary data and LCA analysis. Interviews were conducted to official of DBKK, MPS and MPT, which operate the landfill and interview official recyclable materials collection center. The questionnaires have been distributed to households in the vicinity of DBKK, MPKB, MDT, MDPT, DPG, MPS and MPT. Secondary data for the amount of waste that are sent to landfill is collected. LCA analysis methods is used to determine the contribution of recycling to conserve landfill especially in energy saving. The results showed that there are 8 types of waste disposal sites identified in the DBKK and the MPT, and 9 types composition of the waste in the landfill of MPS. The average amount of waste disposed in landfill DBKK is 13020.29 tons / month, MPS landfill 10611.94 tons / month and MPT landfill 9000 tons / month. All three landfills are not applying any model of sustainable management in their operation. The Contribution of households, collectors and scavengers center in reducing the amount of waste disposal site in Kayu Madang Landfill of DBKK are 4.5% / month, 11.32% / month and 3.72% / month respectively. While the contribution of households, collectors and scavengers central to reducing the amount of waste in MPS landfill are 3.82% / month, 40.4% / month and 0.13% / month. Contribution of household, collectors and scavengers in reducing the amount of waste disposal site in MPT landfill are 0.74% / month, 1.28% / month and 0.38% / month. LCA analysis has found that there are energy savings in the production of new products using recycled materials instead of using the original materials. Also through this finding , the calculation of the life of the landfill can be determined based on the reduction of waste in landfills .*

## SENARAI JADUAL

	Halaman
Jadual 2.1: Komposisi Sisa Pejal (%) Di Beberapa Negara Selatan China	25
Jadual 2.2: Ciri-ciri Bahan Buangan di tiga kawasan berbeza di Malaysia	26
Jadual 2.3: Komposisi sisa di beberapa negara	27
Jadual 3.1: Jumlah sampel pantai barat Sabah	60
Jadual 3.2: Jumlah sampel MPS	61
Jadual 3.3: Jumlah sampel MPT	61
Jadual 3.4: Penggunaan tenaga mengikut jenis bahan	72
Jadual 3.5: Jumlah gas yang dihasilkan oleh kenderaan	73
Jadual 3.6: Jumlah tenaga yang digunakan dalam penghasilan produk berdasarkan bahan semulajadi	73
Jadual 4.1: Komposisi sisa di tapak pelupusan Kayu Madang	78
Jadual 4.2: Jenis komposisi sisa di tapak pelupusan MPS	80
Jadual 4.3: Jenis komposisi sisa di tapak pelupusan MPT	82
Jadual 4.4: Jumlah sampah yang masuk ke tapak pelupusan Kayu Madang Kota Kinabalu tahun 2012 (tan)	85
Jadual 4.5: Purata jumlah sampah yang diterima di tapak pelupusan MPS/ bulan	89
Jadual 4.6: Jumlah responden yang mengamalkan kitar semula mengikut jenis rumah di setiap PBT	93
Jadual 4.7: Jumlah komposisi sisa (kg/bulan) yang dikitar semula mengikut jenis rumah setiap PBT	95
Jadual 4.8: Jumlah komposisi sisa (kg/bulan) yang dikitar semula mengikut jenis rumah setiap PBT	96
Jadual 4.9: Kadar kitar semula mengikut PBT	98
Jadual 4.10: Faktor penglibatan responden dalam aktiviti kitar semula	101

Jadual 4.11:	Faktor penglibatan responden dalam aktiviti kitar semula	102
Jadual 4.12:	Kaedah pengendalian bahan boleh kitar responden di setiap PBT	105
Jadual 4.13:	Kaedah pengendalian bahan boleh kitar isirumah MPS dan MPT	106
Jadual 4.14:	Jenis komposisi sisa (tan) yang dikumpulkan setiap PBT	111
Jadual 4.15:	Jenis bahan boleh kitar dan berat (tan/bulan)	112
Jadual 4.16:	Bahan kitar semula (tan) yang di kumpul oleh 6 syarikat pada tahun 2012	115
Jadual 4.17:	Jumlah bahan boleh kitar (tan) yang dikumpulkan oleh setiap syarikat	118
Jadual 4.18:	Punca bahan kitar semula bagi setiap industri	119
Jadual 4.19:	Jenis bahan kitar semula dan berat bahan yang dikumpulkan oleh <i>Scavengers</i>	120
Jadual 4.20:	Peratusan berat bahan kitar semula dalam sehari	121
Jadual 4.21:	Jenis komposisi sisa yang dikumpul oleh <i>scavengers</i> MPS	122
Jadual 4.22:	Demografi <i>scavengers</i>	123
Jadual 4.23:	Komposisi sisa yang dikumpulkan oleh <i>scavengers</i> MPT Sebulan	124
Jadual 4.24:	Penggunaan tenaga dan penjimatan mengikut jenis komposisi sisa	128
Jadual 4.25:	Komposisi gas tapak pelupusan	129
Jadual 4.26:	Bahan bakar dalam penjanaan elektrik di Malaysia	129
Jadual 4.27:	Faktor emisi campuran bahan bakar untuk penjanaan elektrik (1kwh)	130
Jadual 4.28:	Penjimatan tenaga dalam proses pembuatan menggunakan bahan kitar semula di tapak pelupusan Kayu Madang, DBKK	130
Jadual 4.29:	Jumlah penjimatan gas yang dibebaskan daripada pembuatan dari bahan kitar semula	131

Jadual 4.30:	Penjimatan tenaga dalam proses pembuatan menggunakan bahan kitar semula di kawasan MPS	132
Jadual 4.31:	Jumlah penjimatan gas yang dibebaskan daripada pembuatan dari bahan kitar semula	133
Jadual 4.32:	Penjimatan tenaga dalam proses pembuatan menggunakan bahan kitar semula di kawasan MPT	133
Jadual 4.33:	Jumlah penjimatan gas yang dibebaskan daripada pembuatan dari bahan kitar semula	134
Jadual 4.34:	Jumlah gas yang dihasilkan oleh kenderaan	135
Jadual 4.35:	Komposisi gas tapak pelupusan	136
Jadual 4.36:	Jumlah bahan kitar semula (tan/bulan) yang dikumpulkan bagi setiap kawasan kajian iaitu DBKK, MDKB, MDPG, MDPT, MDT, MPS dan MPT	137
Jadual 4.37:	Jumlah pelepasan gas (tan/bulan) daripada aktiviti pereputan di tapak pelupusan Kayu Madang, DBKK	138
Jadual 4.38:	Jumlah pelepasan gas daripada aktiviti pereputan di tapak pelupusan (tan/bulan) tapak pelupusan MPS	139
Jadual 4.39:	Jumlah pelepasan gas daripada aktiviti pereputan di tapak pelupusan (tan/bulan) tapak pelupusan MPT	139
Jadual 4.40:	Jumlah penjanaan elektrik (1kWh) melalui tenaga gantian dari tapak pelupusan	140
Jadual 4.41:	Pengelasan tapak pelupusan di kawasan kajian	143
Jadual 4.42:	Tempoh hayat tapak pelupusan	144

## SENARAI RAJAH

	Halaman
Rajah 1.1: Kerangka Konseptual	6
Rajah 3.1: Kedudukan kawasan kajian dalam Negeri Sabah	46
Rajah 3.2: Tapak pelupusan Kayu Madang, Kota Kinabalu	47
Rajah 3.3: Tapak Pelupusan Bukit Gemok Tawau	48
Rajah 3.4: Tapak Pelupusan Bukit Gemuk, Tawau	49
Rajah 3.5: Reka Bentuk Kajian	50
Rajah 3.6: Sampel isirumah pantai barat Sabah	58
Rajah 3.7: Sampel isirumah pantai timur Sabah	59
Rajah 3.8: Perbandingan penghasilan produk dari bahan semulajadi dan bahan kitar semula	70
Rajah 4.1: Peratusan sampah yang dihantar dari setiap kawasan	79
Rajah 4.2: Proses Menimbang Sampah	84
Rajah 4.3: Proses pengasingan bahan boleh kitar oleh <i>Scavengers</i>	86
Rajah 4.4: Menimbus sampah dengan tanah	87
Rajah 4.5: Proses pengasingan sisa oleh <i>scavengers</i>	91
Rajah 4.6: Proses penimbusan menggunakan jentolak	92
Rajah 4.7: Taburan pusat kitar semula di Kota Kinabalu	108
Rajah 4.8: Jumlah eksport bahan terpakai oleh syarikat pengumpul mengikut jenis (tan/bulan)	113
Rajah 4.9: Taburan industri kitar semula di Tawau	116
Rajah 4.10: Aliran sampah	125

## **SENARAI LAMPIRAN**

**LAMPIRAN 1**

**LAMPIRAN 2**

**LAMPIRAN 3**

**LAMPIRAN 4**

**LAMPIRAN 5**

**LAMPIRAN 6**

**LAMPIRAN 7**

## KANDUNGAN

	Halaman
<b>TAJUK</b>	i
<b>PENGAKUAN</b>	ii
<b>PENGESAHAN</b>	iii
<b>PENGHARGAAN</b>	iv
<b>ABSTRAK</b>	v
<b>ABSTRACT</b>	vi
<b>KANDUNGAN</b>	vii
<b>SENARAI JADUAL</b>	xiii
<b>SENARAI RAJAH</b>	xvi
<b>SENARAI LAMPIRAN</b>	xvii

### **BAB 1: PENGENALAN**

1.1 Pendahuluan	1
1.2 Latar Belakang	3
1.3 Pernyataan Masalah	5
1.4 Kerangka Teori/Konsep	6
1.5 Matlamat Kajian	7
1.6 Objektif Kajian	7
1.7 Persoalan Kajian	7
1.8 Skop Kajian	8
1.9 Kepentingan Kajian	8
1.10 Rangka Penulisan Tesis	9
1.11 Kesimpulan	11

## **BAB 2 : KAJIAN LITERATUR**

2.1:	Pengenalan	12
2.2:	Teori Dan Konsep Kajian	13
2.3:	Istilah-Istilah Dalam Kajian	14
2.3.1:	Pengurusan Tapak Pelupusan Mapan	14
2.3.2:	Pembangunan Mapan	19
2.3.3:	Kitar Semula	21
2.4:	Kajian Lampau : Kitar Semula Ke Arah Pengurusan Tapak Pelupusan Mapan	22
2.4.1:	Komposisi Sisa	24
2.4.2:	Peranan PBT Dalam Pengurusan Tapak Pelupusan	27
2.4.3:	Kitar Semula Isirumah	31
2.4.4:	Kitar Semula Pusat Pengumpul	34
2.4.5:	Kitar Semula <i>Scavengers</i>	37
2.5:	Penilaian Kitar Hayat (LCA)	41
2.6:	Kesimpulan	43

## **BAB 3: KAWASAN DAN METODOLOGI KAJIAN**

3.1:	Pengenalan	45
3.2:	Kawasan Kajian	45
3.2.1:	Tapak Pelupusan Kayu Madang Kota Kinabalu	46
3.2.2:	Tapak Pelupusan Sandakan (MPS)	47
3.2.3:	Tapak Pelupusan Bukit Gemok Tawau	48
3.3:	Metodologi Kajian	49
3.3.1:	Soal Selidik	51
a.	Soal Selidik Isirumah	53

b.	<i>Soal Selidik Scavengers</i>	55
c.	Teknik Persampen	56
i.	Sampel Isirumah Bahagian Pantai Barat Sabah	60
ii.	Sampel Isirumah Daerah Sandakan (MPS)	61
iii.	Sampel Isirumah Daerah tawau (MPT)	61
3.3.2:	Temubual	61
3.3.3:	Data Sekunder	65
3.3.4:	Kaedah Analisi Data	66
a.	Analisis Soal Selidik	66
b.	Analisis Temubual	67
c.	Analisis Data Sekunder	67
3.3.5:	Analisis Penilaian Kitar Hayat	68
a.	Penilaian Kitar Hayat (LCA) Produk Berasaskan Bahan Mentah	71
i.	Proses Pemerolehan Bahan Mentah	71
ii.	Pengekstrakkan	71
iii.	Pengangkutan	72
3.4:	Kesimpulan	74

#### **BAB 4: ANALISIS DAN DAPATAN KAJIAN**

4.1:	Pengenalan	76
4.2:	Komposisi Sisa Tapak Pelupusan	77
4.2.1:	Komposisi Sisa Tapak Pelupusan Kayu Madang (BDKK)	77
4.2.2:	Komposisi Sisa Tapak Pelupusan Sandakan (MPS)	80
4.2.3:	Komposisi Sisa Tapak Pelupusan Bukt Gemok (MPT)	81
4.3:	Kaedah Pengurusan Tapak Pelupusan	82

4.3.1:	Kaedah Pengurusan Tapak Pelupusan Kayu Madang	82
	a. Proses Penghantaran Sisa Ke Tapak Pelupusan	83
	b. Proses Pengasingan Bahan Boleh Kitar	86
	c. Proses Menimbus	86
4.3.2:	Kaedah Pengurusan Tapak Pelupusan Sandakan	87
	a. Proses Penghantaran Sisa Ke Tapak Pelupusan	88
	b. Proses Pengasingan Bahan Boleh Kitar	88
	c. Proses Menimbus	88
4.3.3:	Kaedah Pengurusan Tapak Pelupusan Bukit Gemok	89
	a. Proses Penghantaran Sisa Ke Tapak Pelupusan	90
	b. Proses Pengasingan Bahan Boleh Kitar	91
	c. Proses Menimbus	91
4.4:	Peranan Isirumah, Pusat Pengumpul dan <i>Scavengers</i>	92
4.4.1:	Kitar Semula Dalam Kalangan Isirumah	93
	a. Komposisi Sisa Kitar Semula Isirumah	93
	b. Faktor Penglibatan Dalam Kitar Semula	99
	c. Kaedah Pengendalian Bahan Kitar Semula	103
4.4.2:	Dapatkan Kitar Semula Di Pusat Pengumpul Kerajaan	108
	a. Kitar Semula Pusat Pengumpul Pantai Barat Sabah	108
	b. Kitar Semula Pusat Pengumpul Kawasan MPS	114
	c. Kitar Semula Pusat Pengumpul Kawasan MPT	116
4.4.3:	Dapatkan Kitar Semula Oleh <i>Scavengers</i>	120
	a. Kitar Semula <i>Scavengers</i> Tapak Pelupusan Kayu Madang	120
	b. Kitar Semula <i>Scavengers</i> Tapak Pelupusan	122

	Sandakan	
c.	Kitar Semula <i>Scavengers</i> Tapak Pelupusan Bukit Gemok	123
4.5:	Penilaian Kitar Hayat (LCA) Ke Arah Tapak Pelupusan Mapan	125
4.5.1:	Kitar Semula	127
a.	Analisis Kitar semula Tapak Pleupusan Kayu Madang (DBKK)	130
b.	Analisi Kitar semula Tapak Pelupusan Sandakan (MPS)	132
c.	Analisis Kitar Semula Tapak Pelupusan Bukit Gemok (MPT)	133
4.5.2:	Pengankutan	135
4.5.3:	Tapak Pelupusan	135
4.5.4:	Rumusan LCA	140
4.6:	Pengelasan Tapak Pelupusan	142
4.7:	Kesimpulan	146

## **BAB 5: PERBINCANGAN**

5.1:	Pengenalan	148
5.2:	Perbincangan	148
5.3:	Kesimpulan	154

## **BAB 6: CADANGAN DAN KESIMPULAN**

6.1:	Pengenalan	155
6.2:	Rumusan	155
6.3:	Cadangan	157
6.4:	Kesimpulan	161

## **RUJUKAN**

162

**LAMPIRAN 1**

**LAMPIRAN 2**

**LAMPIRAN 3**

**LAMPIRAN 4**

**LAMPIRAN 5**

**LAMPIRAN 6**

**LAMPIRAN 7**



# BAB 1

## PENGENALAN

### 1.1 Pendahuluan

Isu tapak pelupusan telah bermula sejak awal tamadun manusia sekitar 10000 SM lagi (Worrell dan Vesilind, 2012). Kewujudan masalah pelupusan sisa ini telah menjadi cabaran kepada pihak tertentu khususnya Pihak Berkuasa Tempatan (PBT) untuk memikirkan cara yang terbaik untuk melupuskan sisa. Pada tahun 1830, isu kesihatan dan pengurusan sisa telah tercetus di peringkat antarabangsa yang bermula di London dan kemuncak daripada itu pelantikan Suruhanjaya Sanitasi untuk menangani masalah penyakit dan kebersihan awam diwujudkan (Wilson, 2007). Melalui penubuhan suruhanjaya ini, pelbagai cadangan dan usaha telah dikemukakan termasuklah cadangan pengurusan sisa pejal yang lebih baik melalui undang-undang, penguatkuasaan, pelaburan dan infrastruktur. Usaha ini diteruskan lagi dengan penubuhan Akta Kesihatan Awam pada tahun 1848 dan 1875 yang memfokuskan kepada peranan isi rumah untuk menguruskan sisa buangan harian mereka. Setiap isi rumah dibekalkan bekas mudah alih untuk mengisi sisa pejal mereka yang kemudiannya akan dikutip oleh PBT setiap minggu (Wilson, 2007).

Tujuan utama pengurusan tapak pelupusan adalah untuk menangani masalah kesihatan, alam sekitar, estetika, guna tanah, sumber dan keimbangan ekonomi (Henry *et. al.*, 2006, Nemerow, 2009 dan Wilson 2007). Menurut Hasnah *et. al.*, (2012), isu tapak pelupusan bermula daripada masalah pengurusan sisa yang tidak sistematik yang menyebabkan lambakan sampah di tapak pelupusan. Isu lambakan sampah di tapak pelupusan berpunca daripada kadar penjanaan sisa yang semakin meningkat setiap hari seiring dengan pertambahan jumlah penduduk, kepesatan ekonomi, perbandaran dan pembandaran serta peningkatan taraf hidup masyarakat (Minghua *et. al.*, 2009 : Guerrero *et. al.*, 2013, Goh, 1990). Dianggarkan penjanaan sisa oleh 3 *billion* orang adalah sebanyak 1.2 kg per orang setiap hari (1.3 billion

tan per tahun). Jumlah ini dianggarkan meningkat pada tahun 2025 kepada 2.2 billion tan per tahun (World Bank, 2013). Permintaan terhadap produk baru ini akan menggiatkan lagi penerokaan terhadap sumber asli (Menikpura et.al., 2013 dan Plaganyi et.al., 2013). Penerokaan sumber asli khususnya bahan makanan di peringkat global telah mencatatkan pengeluaran sisa pejal setiap tahun sebanyak 3400 juta hingga 4000 juta tan sisa (Giljum et. al., 2008 dan Chalmin dan Gaillochet, 2009).

Kawasan perbandaran di Asia telah menghasilkan hampir 70 million tan sisa setiap tahun dengan jumlah penjanaan per kapita sebanyak 0.12 hingga 5.1 kg per orang setiap hari (anggaran purata 0.45 kg/kapita/hari) (World Bank, 2013). Sisa pejal perbandaran terdiri daripada bahan-bahan seperti kontena, bungkusan, sisa makanan, sisa halaman serta bahan buangan bukan bersifat organik (U.S EPA, 2002). Manakala sisa bukan organik terdiri daripada bahan seperti kaca, peralatan dapur, tin, aluminium, besi ferum dan debu (Tchobanoglous et. al., 1993). Negara Malaysia juga mengalami masalah yang sama dimana jumlah perhasilan bahan sisa pejal di kawasan bandaraya meningkat kepada purata 760,000 tan setiap hari (Zamali Tarmudi et. al., 2009).

Dalam konteks negara Malaysia, masalah yang sama turut berlaku di mana hanya terdapat 7 daripada 289 tapak pelupusan yang dikelaskan sebagai tapak pelupusan bersifat sanitari dan mesra alam, manakala selebihnya (289) adalah tapak pelupusan terbuka (*open dumping*). Ini bermakna hanya sebahagian kecil (kurang 2.5%) tapak pelupusan di negara Malaysia diurus dengan baik. Selain daripada itu, pelbagai masalah lain yang timbul akibat pengurusan tapak pelupusan yang tidak ideal seperti masalah cecair lesapan (*/eachate*), pelepasan gas tapak pelupusan (LFG) dan masalah pencemaran bau. Keadaan ini ditambah lagi dengan ketiadaan konsep pengurusan tapak pelupusan secara mapan yang jelas dilaksanakan oleh Pihak Berkuasa Tempatan (PBT) di negara kita menyebabkan masalah pengurusan tapak pelupusan tidak selesai.

## **1.2 Latar Belakang**

Kajian ini merupakan sub bidang dalam ilmu geografi alam sekitar yang memfokuskan kitar semula sebagai elemen utama dalam pengurusan tapak pelupusan. Keperluan kepada satu bentuk pengurusan tapak pelupusan mapan sangat penting bagi menangani masalah pertambahan sisa yang sangat drastik di tapak pelupusan. Oleh itu konsep pengurusan tapak pelupusan mapan perlu diwujudkan di setiap negara baik dari jenis tapak pelupusan terbuka maupun sanitari. Pelbagai definisi konsep tapak pelupusan mapan telah diperkenalkan oleh beberapa sarjana dan dipraktikkan di sesebuah negara yang mana tujuan akhir yang hendak dicapai adalah sama iaitu meminimumkan kesan alam sekitar (Huber-Humer *et. al.*, 2010: Barlaz, 2005 : Barlaz, 2005). Matlamat pengurusan tapak pelupusan mapan adalah untuk mencapai tahap stabil iaitu sisa yang dilupuskan tidak memberikan ancaman kepada kesihatan manusia dan alam sekitar (Barlaz, 2005). *Environmental Agency* (2005), menyatakan hal yang sama namun menambah aspek kestabilan fizikal, kimia dan biologi tapak pelupusan. Sesebuah tapak pelupusan akan dikategorikan sebagai mapan apabila sistem pemantauan terhadap cecair lesapan, gas dan langkah-langkah perlindungan alam sekitar tidak diperlukan kerana telah mencapai tahap selamat dan berada di tahap penerimaan alam sekitar (Hjelmar, 2005). Menurut Stegmann (2003), tapak pelupusan dikatakan mapan apabila sisa yang dilupuskan tidak perlu dirawat kerana potensi pelepasan bahan gas dan cecair lesapan adalah rendah dan tidak menjaskan alam sekitar.

Terdapat elemen-elemen yang perlu ada dalam pengurusan tapak pelupusan mapan. Elemen yang diperkenalkan adalah operasi di tapak pelupusan dan pemantauan (Landfill Guidelines, 2000), rawatan sisa di tapak pelupusan, pengurangan jumlah sisa melalui kitar semula (Allen, 2001), kompos dan guna semula sebagai sumber tenaga (Visvanathan *et. al.*, 2003: DEFRA, 2005 : ECOTEC 2000). Terdapat juga elemen teknologi yang diperlukan untuk mencapai mapan iaitu menggunakan biorektor, equifill dan monolith (Woelders *et. al.*, 2005).

Kesemua definisi konsep tapak pelupusan mapan dan metod pelaksanaan konsep tapak pelupusan hanya berlaku di sekitar sempadan tapak pelupusan

sahaja seperti pemantauan di tapak pelupusan, rawatan dilakukan di peringkat tapak pelupusan, kitar semula sisa di tapak pelupusan, kompos dan guna semula bahan sisa di tapak pelupusan. Selain itu, elemen yang dinyatakan juga memerlukan bantuan teknologi seperti reka bentuk tapak pelupusan, mesin pengasingan bahan boleh kitar serta kaedah rawatan sisa menggunakan biorektor (Heijo, 2015). Untuk mencapai tahap kemapanan tersebut memerlukan teknologi dan dana yang tinggi. Perkara ini menjadi penghalang kepada negara-negara sedang membangun dan negara dunia ketiga untuk melaksanakannya. Oleh itu, kajian ini akan meneroka dan memperluaskan lagi konsep pengurusan tapak pelupusan mapan khususnya di negara-negara yang mempunyai masalah kos pengendalian operasi di tapak pelupusan untuk menguruskan tapak pelupusan secara mapan.

Berdasarkan kepada punca masalah di tapak pelupusan yang dikenalpasti, iaitu jumlah sisa yang dihantar ke tapak pelupusan adalah tinggi, maka konsep pengurusan tapak pelupusan mapan tidak hanya berfokus kepada sempadan ruang tapak pelupusan sahaja malah perlu mencakupi semua peringkat pengurusan sisa mapan iaitu bermula dari sumber sisa (kawasan perumahan), pengutipan, pengumpulan, pengangkutan, rawatan dan pelupusan (Heijo, 2015 dan Allen 2001). Hal ini jelas dinyatakan oleh Allen (2001), konsep pengurusan tapak pelupusan perlu melalui beberapa peringkat proses yang bermula dari peringkat pengurangan penghasilan sisa, seterusnya pengurangan sisa di peringkat sumber, kitar semula dan guna semula, rawatan awal untuk mengurangkan kuantiti, pelupusan sisa di tapak pelupusan dan rawatan lanjut untuk pemuliharaan tapak pelupusan setelah penutupan. Heijo (2015), turut menjelaskan tentang konsep pengurusan tapak pelupusan melalui pendekatan pencegahan, kitar semula dan guna semula. Pencegahan daripada penghasilan sisa perlu diurus diperingkat sumber sisa dan kitar semula dan guna semula perlu dilakukan diperingkat penjanaan sisa. Dalam hal ini, peranan masyarakat amat penting dalam mengurangkan jumlah sisa.

Mengurangkan jumlah sisa dari peringkat sumber akan memudahkan urusan sisa di tapak pelupusan khususnya dari segi rawatan di tapak pelupusan. Jumlah sisa yang dikitar semula di peringkat sumber dan di peringkat tapak pelupusan

berupaya mengurangkan jumlah sisa yang dilupuskan di tapak pelupusan. Terdapat tiga perkara yang ditekankan dalam kajian ini iaitu kitar semula di peringkat sebelum (isirumah dan pusat pengumpul), semasa (pengasingan sisa di tapak pelupusan oleh *Scavengers*) dan selepas sisa dilupuskan (penilaian kitar hayat). Sisa yang dikitar semula akan mengurangkan ketepuan tapak pelupusan seterusnya memudahkan pengurusan sisa dan memanjangkan tempoh hayat tapak pelupusan.

### **1.3 Penyataan Masalah**

Tapak pelupusan yang diuruskan secara mapan mampu untuk memanjangkan tempoh hayat tapak pelupusan. Selain itu, tapak pelupusan yang diurus secara mapan juga dapat mengurangkan pelbagai masalah yang wujud seperti pencemaran udara, pencemaran air, masalah penyakit bawaan dan masalah penyakit berjangkit yang berpunca dari tapak pelupusan. Namun demikian kebanyakkan tapak pelupusan di dunia ini diuruskan secara tidak mapan dan menggunakan kaedah kovensional seperti tapak pelupusan terbuka. Hanya beberapa negara membangun dan maju sahaja yang menggunakan tapak pelupusan sanitari yang dikatakan mampu untuk melupuskan sisa secara selamat. Masalah lambakan sisa yang semakin tinggi di tapak pelupusan menjadi punca utama kepada kegagalan pengurusan sisa di tapak pelupusan baik tapak pelupusan terbuka maupun tapak pelupusan sanitari. Lambakan sisa telah melumpuhkan sistem pengurusan tapak pelupusan menyebabkan tapak pelupusan terpaksa ditutup lebih awal kerana tepu dengan sampah. Hal ini ditambah lagi dengan ketiadaan kaedah pengurusan tapak pelupusan mapan yang jelas diperkenalkan dalam pengurusan tapak pelupusan. Kebanyakkan definisi dan konsep yang diperkenalkan hanya berkisar pada komponen teknologi, reka bentuk dan pengurusan tapak pelupusan pada kadar sempadan tapak pelupusan sahaja. Pelbagai usaha telah dijalankan untuk mengatasi masalah ini seperti pengenalan insinarator, pembinaan tapak pelupusan sanitari dan pengenalan model teknologi dalam pengurusan. Namun demikian masalah lambakan sampah di tapak pelupusan tetap berlaku dan wujud konflik antara cadangan penutupan tapak pelupusan sebelum tempoh operasi dengan kesukaran mencari tanah yang sesuai untuk mengantikan tapak pelupusan sampah sedia ada. Oleh itu, untuk memberikan kelangsungan kepada tapak pelupusan agar dapat digunakan secara maksimum dan

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