CHAPTER 1

INTRODUCTION

1.0 Introduction

Solid wastes (SW) are inherent product of our society since the beginning of civilization. The population growth, urbanization and industrialization along with increased of land usage for residential, commercial and industrial purposes make it as crucial problems (Herbert, 2001). Municipal solid waste management (MSWM) has been and will continue to be a major issue faced by countries world. Developing countries are the most affected due to the dramatic increase in total amount of municipal solid waste (MSW) generated as a result of rapid industrialization, population growth and economic development. As such, Malaysia, being a developing country, is also facing a growth in urbanization and a modification in regional consumption patterns.

1.1 Overview of Municipal Solid Waste (MSW)

The Solid Waste and Public Cleansing Management (SWPCM) Act 2007 Part 1: Preliminary- Interpretation defined solid waste and controlled solid waste as;

a) *Any scrap material or other unwanted surplus substance or rejected products arising from the application of any process;*
b) *Any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled; or*
c) *Any other material that according to this Act or any other written law is required by the authority to be disposed of, but does not include scheduled waste as prescribed under the Environmental Quality Act 1974 [Act 127], sewage as*

defined in the Water Services Industry Act 2006 [Act 655] or radioactive waste as defined in the Atomic Energy Licensing Act 1984 [Act 304].

Based on Agamuthu and Nather (1997) solid waste is defined as unwanted waste which comes from human and animal activities that are normally solid. There are many components in solid waste such as domestic waste, organic waste, combustible and non-combustible wastes, construction and demolition wastes, industrial wastes and hazardous wastes. As a fact, the current global MSW generation levels being approximately 1.3 billion metric tonnes (MT) per year or 1.2 kg per person per day on average (Hoorweg, 2012). Hoorweg (2012) defined MSW as encompassing residential, industrial, commercial, institutional, municipal, and construction and demolition (C&D) waste. Hoorweg (2012) report expects the MSW generation to increase to approximately 2.2 billion metric tonnes per year by 2025.

Specifically the household waste generation in Peninsular Malaysia is about 18, 000 metric tonnes per day (KPKT, 2013). With the population 22 million, the per capita waste generation is about 0.8 kg/capita/day. On average, the waste generation by urban (0.83 kg/capita/day) is relatively higher than the waste generation by rural (0.73 kg/capita/day) (KPKT, 2013). The waste consists of garbage about (0.1-1.0 kg/capita), ash (0.05-1.5 kg/capita) and rubbish varies from (0.2-0.8 kg/capita) in a day (Agamuthu and Nather, 1997).

Waste generation is defined as the solid waste produced from its source. It is the total waste retained by the source that will end up being discarded. The waste generation refers to the weight of materials and products as they enter the waste management system from sources but before being subjected to treatment which includes material recovery or combustion processes. Source reduction activities (e.g. backyard

composting) and industrial scrap are not included in the generation estimates.

The generation rate is the amount of waste generated by one person or other appropriate units, which includes employees, square meters, etc. in one day and is presented as kg per capita per day (based on population) or kg per employee per day. The generation rates are influenced by;

- Societal affluence
- The standard of living and organization
- The degree of industrialization
- Public habits
- Local climate

Generally the higher the economic development and extent of urbanization, the greater the amount of solid waste produced. It has been determined that the composition, as well as the generation rate of SW in urban areas is similar to that which is generated in developed countries. As an example, Delhi is the most densely populated and urbanized city of India (Talyan *et al*., 2008**)** which is also a commercial hub, providing employment opportunities and accelerating the pace of urbanization, resulting in a corresponding increase in municipal solid waste (MSW) generation presently (Talyan *et al.,* 2008). The annual growth rate in population during the last decade 1991-2001 was 3.85%, almost double the national average (Talyan *et al.,* 2008).

While, Otoniel and Gerardo (2003) reports that 56% of the municipal waste in Guadalajara metro area comes from homes and the balance of 44% comes from a variety of sources such as public parks, markets, streets, governmental institutions, schools, commercial centers and etc. In Selangor state, the highest percentage of MSW

consisted of putrescible waste of approximately 46%, followed by plastic and paper at 15% and 14%, respectively (Fauziah *et al.*, 2004) and almost 98% of this MSW would end up in landfills (Fauziah *et al.*, 2004) including recyclable materials. Therefore, the best strategy for Malaysia to reduce waste materials in landfill is to include recycling programs in waste management options. Recycling is a resource recovery and reprocessing of waste to recover the original raw materials. Agamuthu and Nather (1997) summarised that recycling can conserve non-renewable resources such as metals and petroleum, conserve energy, protect and enhance the environment, conserve land and reduce pollutant emissions. The recycling activities in Malaysian landfills mostly are conducted by small recycling firms or individual person.

1.2 Problem statement

The MSW disposal, especially domestic household waste is a challenge to the Malaysian local governments due to increasing waste generation every year and a continuous growth of economic and population in Malaysia. According to Yong *et al.* (2007) if solid wastes are not recycled, the landfills will be exhausted very quickly, necessitating the construction of new ones.

Cities in developing countries nowadays find that the best way in waste management system is one in which they integrate, the recycling method and source-separated materials in the system (Agamuthu, 2010). Kaseva and Gupta (1996) reported that solid waste recycling reduces environmental damage and is an important-substitution economic activities which also saves energy, conserves resources and saves waste collection and disposal costs. In Malaysia, recycling and separation of waste is carried out by a great numbers of formal and informal waste management sectors agents known as waste picker. Country and city leaders, as well as those in the formal waste

management sector, usually consider the waste picking activity as an old way and need to be phased out to create a modern waste management system and, indeed, a modern city (Agamuthu, 2010). For them, once the rubbish has been compressed mechanically, it can only be dumped and no recycling is possible (Agamuthu, 2010).

Waste pickers have been scratching out a living on the margins of urban solid waste systems since these systems came into being, taking advantage of the status of waste materials as common property resources and earning, in general much more than minimum wage (Anne *et al*., 2006). While picking may provide a solution and a livelihood for pickers, it is often seen as a problem by formal authorities and development agents. With the intention of helping the waste pickers, development intervention focus on waste pickers' welfare needs or rights, and not on their professional activities; An approach which may disrupt livelihoods and fail to meet the needs of the pickers themselves (Anne *et al.*, 2006).

The modernization of waste management systems open new niches and puts governments and the formal private sector into new relationships to each other. In the process, it allocates both responsibilities and rights around waste in new ways (Anne *et al.*, 2006). In this process, waste pickers can be losers, but they can also be winners, especially when waste picking is contextualized as providing new opportunities for waste picking, and as contributing to solving the waste management problem by keeping materials out of landfills (Anne *et al.,* 2006). The best chance to support sustainable and positive change comes when there is a commitment to work with waste pickers embedded to their professional context, and to support them in finding and entering the better and more stable economic niches that can open during the process of modernizing the waste management system (Anne *et al.,* 2006).

The waste pickers do not get any technical training from the authorities and carry out their job solely by experience. The problems arising from MSW and uncontrolled land filling practices has resulted in growing environmental impacts such as methane production, leachate contamination, pest problem and others (Fauziah and Agamuthu, 2009; Agamuthu, 2010). This situation presents a serious public health risk to the waste pickers (Otoniel and Gerardo, 2003). The waste pickers can also be manipulated especially by middlemen. They are paid as low as 5% of the price that industry pays for recyclables (Medina, 2000). Though waste pickers play a role in reducing waste in landfill, other factors particularly their health and socio-economic well-being are not given appropriate concern.

The socio-economic aspect of waste pickers deserves careful study as to determine the factor which encourages them to be a part of the formal waste management systems. Based on the above view, this research is designed to study the socio-economic aspect of the waste pickers at three types of waste disposal site in Malaysia. It is hoped that this study will create an awareness of the existence and the potential importance of waste pickers among the members of the government and public. It is also hoped that the results of this study will be of help to not only waste pickers, but also to the future of waste management in Malaysia.

1.3 Objectives of the study

The objectives of this study are:

i. To compare the socio-economic background of waste pickers in three types of landfills.
ii. To highlight the working life and problems that waste pickers face at work.
iii. To determine the level of environmental awareness among the waste pickers.

1.4 Scope of the study

The scope of the study involved three types of landfills (sanitary, control dump and open dump) in Selangor in 2011 and 2012. The comparative studies on socio-economic of waste pickers were investigated. Information on environmental awareness was correlated with the living standards of waste pickers, educational background and other factors. Waste scavenging options including recycling of the waste were identified and the possibility and viability of recycling were examined.

CHAPTER 2

LITERATURE REVIEW

2.1 Solid Waste Management in Malaysia

Before 1999, solid waste management in Malaysia has been managed by the state local's authority. The speedy development has increased the quantity of solid waste generated in Malaysia and the solid waste management costs also have increased. These scenarios contribute complications to the local authorities to cope with the disposal of waste. The government in September 1995 initiated the privatization of SW disposal by appointing four consortiums to manage and improve the quality of solid waste management for the whole country. Thus, four consortiums were selected by the government are proposed to the given 20 year's concession to manage solid waste. Privatization has been applied on a temporary basis beginning on 18 April 1998 before full privatization is in force.

However the privatization of SWM for the whole country could not be accomplished due to unsolved key issues in the SWM process namely the enactment of a new Solid Waste Act that addresses the privatization move. The Federal Government endorsed the Act in 17 July 2007 to transfer responsibility of solid waste management from local authorities to the central government. On 30 August 2007, the Federal has gazetted the Solid Waste and Public Cleansing 2007 (Act 672). Under this act, the federal government has been given the authority to make decision on solid waste management and public cleansing particularly in Peninsular Malaysia. This Act has come into force in 1 September 2011 in Peninsular Malaysia with exception Labuan, Pulau Pinang, Perak, Selangor, Terengganu and Kelantan. The concessions appointed to carry out

solid waste management and public cleansing are:

- Alam Flora Sdn. Bhd. (Kuala Lumpur, Putrajaya & Pahang) Central and East zone
- Environment Idaman Sdn. Bhd. (Kedah and Perlis) North zone
- SWM Environment Sdn. Bhd. (Johor, Melaka and Negeri Sembilan South zone

National Solid Waste Management Department (JPSPN) was established as the party responsible in making policies, regulations, guidelines, strategic plans, and issuing licenses. In the year 2007, the Solid Waste Management Act and Public Cleansing 2007 (Act 672) were endorsed to establish the Solid Waste and Public Cleansing Management (Act 673) (PPSPPA). PPSPPA was established to enforce Act 672 and the rules there under, implement strategic plans, overseeing the operation amenities and solid waste management in the country.

2.1.1 Solid waste generation in Malaysia

The waste generation in Malaysia is on the rise annually due to uncontrolled consumption by the ever increasing population and the changing lifestyle. With population growth rate of 2.4%, or about 600,000 per annum, it is predicted that the piles of garbage produced each day will be as big as 20 football fields with a thickness of one meter (Aslam, 2013). Average waste generation of citizens in Malaysia is 0.80 kg/capita/day, and 1.25 kg/capita/day in the city center of Kuala Lumpur (Aslam, 2013). While Georgetown city produces approximately about 30000 to 33000 tonnes/day of waste in 2013, a big increase from 17,000 tonnes in 2005 and 22,000 in 2012 (PPSPPA, 2013). A total of 9.1 million tonnes of waste will be produced annually by 36 million people by 2020 (Aslam, 2013). A cost of 1.6 billion per year should be allocated to

manage waste including the cost of transfer station, incinerator management, tipping fees and others. The expensive cost for management (Aslam, 2013) causes the user to choose the easy way to throw rubbish into the dustbin.

Table 2.1 shows waste generation per capita by region. Klang Valley residents produce the most waste, 1.35 kg/capita/day than any other regions whereas the East Coast has the lowest waste generation rate of 0.95 kg/capita/day. The State of Selangor is the number one producer of waste, approximately 2995 tonnes daily, followed by Kuala Lumpur with 1634 tonnes, Johor with 2002 tonnes, Perak with 1596 tonnes, and Kedah with 1383 tonnes daily (Azrina, 2013).

Table 2.1: Waste Generation by Region

Region	**Population**	**Per Capita (kg/capita/day)**	**Total (MT/day)**
Northern	6,093,318	1.10	6,724
Klang Valley	7,209,175	1.35	9,702
East Coast	4,076,395	0.95	3,862
Southern	5,190,457	1.28	6,657
Sarawak	2,471,140	1.04	2,571
Sabah	3,293,650	0.98	3,220
Total	**28,334,135**		**32,736**

Source: KPKT (2013).

On average, the annual rate of increase from 2003 to 2008 was 3.5% (KPKT, 2013). It has been argued that the rapid growth of urban population and Gross Domestic Product (GDP) (i.e. economic activity) were the main factors that led to this increase. This result suggests that total MSW collected has been mostly decoupled from urban economic activity. With increasing income and quality of life, MSW has changed in composition rather than increased in total amount.

2.1.2 Solid waste composition in Malaysia

Solid waste composition in Malaysian landfill varies with each landfill. The composition is based on socio economic and lifestyle of the household there. On average, the solid waste compositions in Malaysian landfills are approximately 72% compostable such as organic waste, paper, textile and wood (Agamuthu, 2001; Fauziah *et al.*, 2004). Based on Ninth Malaysia Plan, food wastes contributed 45%, followed by plastic products 24%, 15% of others waste, 7% of paper, 6% of metal and 3% of glass as indicated in Figure 2.1 (KPKT, 2013). Approximately 40% of recyclable materials are paper, plastic, steel and glass.

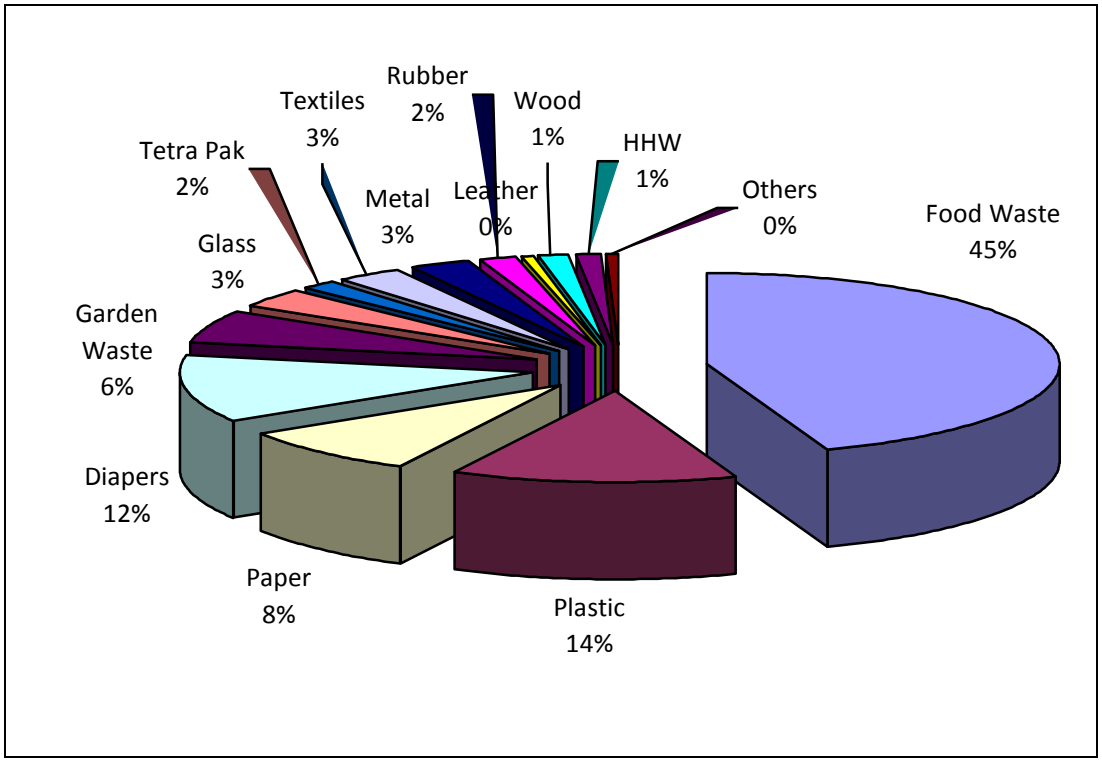

Figure 2.1: Malaysian Household Waste Composition (KPKT, 2013).

Recycling is seen as the best method to generate income especially to the waste pickers since plastic is the highest percentage of recycled materials in the composition of the waste in Malaysia. According to the Director of the Office of Domestic Trade,

Cooperatives and Consumerism Ministry of Sarawak Wan Ahmad Uzir Wan Sulaiman 8 billion of plastic bags used by people in Malaysia in a year (BorneoPost, 2011) whereas the period to destroy plastic take a long time, up to 500 years (BorneoPost, 2011).

The biggest waste composition in the national waste composition is food waste constituting about 45%. Plastics and paper were 14% and 8% respectively. The biggest deviation in the waste composition of the quantity of the waste component is "diapers" found in the waste. About 12% of the waste contained disposable diapers and disposable feminine sanitary products. This is the consequence of the cheap and easily accessible diapers in the market (KPKT, 2013). Asian countries, with the exception of Japan is dominated by organic waste, comprising approximately 75% of the total waste stream (Agamuthu *et al.*, 2007). For Malaysian cities, it is clear that food and vegetable wastes are the dominant components in the waste stream. Most of it comes from the kitchen in the form of peelings, bones, seeds and other by-products of food preparation processes starting from fresh produces and raw ingredients.

Selangor, as one of the fastest developing state in Malaysia has approximately 120 wet markets place operating throughout the state (Fauziah and Agamuthu, 2007). The main wet market in Selangor has a daily generation of 15 tonnes of organic waste which was disposed of into sanitary landfills (Fauziah and Agamuthu, 2007). Current waste composition indicates a very high percentage of putrescible waste, which mainly consists of processed kitchen waste and food waste (KPKT, 2013). Highly commingled, the waste contains high moisture content (more than 80%) (Fauziah and Agamuthu, 2007). This situation would be troublesome for waste pickers in finding materials that can be recycled thus will reduce the value of the recyclables items.

2.2 Recycling

Recycling is defined as the separation and collection of waste materials (Tchobanoglous *et al.*, 1993) and its reuse, which could include repair, remanufacture and conversion of materials, parts, products (Kaseva and Gupta, 1996) and processing of waste materials to produce a marketable material or product (Harrison and Hester, 2002).

The objective of recycling program is to reduce the nation's generation of SW (Agamuthu *et al.*, 2011). Many studies have reported that the implementation of recycling managed to boost economic activities, reduce the utilization of natural and environmental resources (Sharma *et al.*, 1997) reduce environmental impacts, prevent the loss of resources and lengthen the lifespan of operating landfills (Agamuthu *et al.*, 2011). Recycling is not only is good for the environment, but also benefits the manufacturers due to salvaged material being already pre-treated and requiring only minor processing before being recycled into the manufacturing stream (Agamuthu *et al.*, 2007). These are some of the potential benefits from recycling for developing countries.

Recycling is the most effective ways to save natural resources like water, trees, minerals and others (Agamuthu, 2010). The usage of recyclable materials will reduce production processes, emissions into air, water and reduce the need for new landfills areas (Harrison and Hester, 2002; Agamuthu, 2010). Recycling gives added value to materials and in many cases, provides substitutes for the natural resources usually used in making products. Furthermore, recycling also has social benefit such as providing a livelihood for unskilled workers in a developing country by allowing them to recover recyclable materials from solid wastes (Sharma *et al.*, 1997). Furthermore, the technological requirements for recycling is low (Sharma *et al.*, 1997).

The first official 3Rs strategies in Malaysia was launched in late 1980 where campaigns focused mainly on the recycling activities (Agamuthu *et al.*, 2011). Then, National recycling programme was officially launched on December 2, 2000 by the Ministry of Housing and Local Government (PPSPPA, 2002). About 60% of the allocation was used to increase awareness among public in Malaysia every year (PPSPPA, 2002). But the recycling rate in Malaysia is still low (5%) compared to other developed countries such as German (74%), Belgium (71%), Austria (67%) and Netherlands (66%) (Fauziah, 2010a) because recycling in Malaysia is still at an early stage and has not yet been widely implemented. The ministry aims to achieve about 22% rate of recycling goals in 2020 (PPSPPA, 2002).

The concept of 'waste to money' can be further propagated when citizens begin to recognize waste materials as recyclable material. The view that on recycling saves money in the community will encourage recycling activities. . A good approach would be to give encouragement and incentives to the people thus allowing them to focus more on the 'carrot' rather than the 'stick'' – which would mean greater investment in making recycling easier (less effort) should first be established. The point here, they thought that the local authority must initiate a recycling program first before they make it compulsory to the public. If waste behavior is to be transformed as required, building trust and dialogue with household customers of recycling services will be at least as significant as providing extra facilities and new services. The most effective strategy to increase public participation in this activity is to provide consumers with the necessary amenities such as well placed, separate collection bins, and to set up a good garbage collection schedule to prevent the bins from being overloaded.

The average recyclable materials in households waste stream in Malaysia is about 0.07 kg/capita/day (Table 2.2). For the industrial, commercial and institutions (ICI), the recyclable materials are about 0.03 kg/capita/day (Main Report KPKT, 2013). The estimated recyclable materials collected by waste collection truck workers and waste pickers are about 0.02 kg/capita/day (Main Report KPKT, 2013). Overall, the average weight of recyclables material is 0.12 kg/capita/day. On closer inspection, it can be seen that there is very little recycling done as compared to the production of waste by Malaysians daily.

Table 2.2: Recycling Details for Malaysia, in kg/capita/day

	Households (a)	**Industrial, Commercial and Institutions (ICI) (b)**	**Waste Collection Truck Workers and Scavengers (c)**	**Overall (a+b+c)**
Recyclable materials	0.07	0.03	0.02	0.12
Waste discarded	0.69	0.37	-	1.06
Waste generated	0.76	0.41	-	1.17

Source: Main Report KPKT (2013).

2.3 Landfill

Ultimately, something must be done with the solid wastes that cannot be recycled. These are the residual matter remaining after solid wastes have been separated at a materials recovery facility and the residual matter remaining after the recovery of conversion products of energy (Tchobanoglous *et al.*, 1993). There are only two alternatives available for the long-term handling of solid wastes and residual matter; disposal on or in the earth's mantle, and disposal at the bottom of the ocean

(Tchobanoglous *et al.*, 1993). Landfill according to International Solid Waste Association (ISWA, 1992) is "*the engineered deposit of waste onto and into land in such a way that pollution or harm to the environment is prevented and through restoration, land provided which may be used for another purpose".* Landfilling, involves the controlled disposal of wastes on or in the earth's mantle, and it is by far the most common method of ultimate disposal for waste residuals. Landfilling is the lowest rank in the IWM hierarchy because it represents the least desirable means of dealing with society's wastes (Tchobanoglous *et al.*, 1993).

Landfill can be in various forms; hence even open dumps are considered landfills. For a sustainable waste management, landfills can basically be in the form of sanitary landfill or secure landfill. Slight variation in their designs helps to make their functions different. Modern landfill sites are designed and managed as an engineering project in which the waste is degraded to a stabilized product, the product leachate is treated to minimize pollution and the landfill gas is recovered for energy. Older landfill sites, however, were not designed to such standards and may still be emitting pollutants to the environment (Harrison and Hester, 2002).

Based on the technology applied, landfills can be classified into four main classes; open dumps, controlled dumps, sanitary landfill and secure landfills. The consequent sections compare the individual landfills on the design and other requirements. Table 2.3 shows location of landfills in Malaysia. There are 296 landfills nationwide. About 97% of the landfill consists of open dumping. Sarawak has the highest landfill (49) followed by Sabah (19) Perak (17), Pahang (16) and Johor (14) (KPKT, 2012).

Table 2.3: Locations of landfills in Malaysia

State	Operated landfill			Non-operated landfill	Total
	Open Dump	Sanitary Landfill	Inert Landfill		
Johor	12	2	-	23	37
Kedah	8	-	-	7	15
Kelantan	13	-	-	6	19
Melaka	2	-	-	5	7
Negeri Sembilan	7	-	-	11	18
Pahang	16	-	-	16	32
Perak	17	-	-	12	29
Perlis	1	-	-	1	2
Pulau Pinang	2	-	1	1	3
Sabah	19	-	-	2	21
Sarawak	46	3	-	14	63
Selangor	3	3	2	14	22
Terengganu	8	-	-	12	20
WP Kuala Lumpur	0	-	-	7	7
WP Labuan	1	-	-	0	1
Total	**165**	**8**	**3**	**131**	**296**

Source: Department of National Solid Waste, Malaysia (2013).

Among the 166 active sites, 155 from them are open dumping, 8 are sanitary landfills and three are inert landfill. This means that only 5% of the total existing disposal sites in the country are sanitary landfills while the remaining are non-sanitary landfills. This result show that the management of waste in Malaysia is a more subtle matter to tackle (Fauziah, 2010b). In addition, many landfills have opted to close rather than meet the new requirements while the quantity of waste generated yearly is much quicker than the natural degradation process (Fauziah, 2010b).

2.3.1 Open Dumping

Resource Conversation and Recovery Act (1985) defines open dumps to be *"facilities which do not comply with EPA's Criteria for Classification of SW Disposal Facilities and Practices (40 CFR 257)"*. Therefore, regulations firmly banned its operation (USEPA, 1998). Open dump is the simplest type of land disposal site. It is not equipped with leachate control and gas generation monitoring system (Fauziah, 2010b). This resulted in contamination to the surrounding environment with various persistent compounds which are detrimental to human health. The presence of pests such as rodents and insects will only increase the health risks faced by workers at the landfill due to the spread of diseases and others contagious medical conditions. Open dumps may also a source of unpleasant odor that can disrupt the quality of life of residents nearby. They will also affect the price of land in the area (Fauziah, 2010b). Besides lacking in safety features, open landfills are usually open to anyone to enter. Most poor countries still utilize open dumps in their waste management system (Fauziah, 2010b).

2.3.2 Controlled dump

Fauziah, (2010b) defines a controlled dump as *"a waste disposal area whereby the siting, operating, monitoring and management are planned accordingly"*. The hydro-geology aspect and the capacity of waste to be received at the controlled dumps are the elements that authorities must consider before plan to site the controlled dumps because it must produce less environmental risk.

Costs required to manage controlled dump is less than the cost of managing sanitary landfills (Fauziah, 2010b). Controlled dumped is compulsory to hedge their area to avoid non authorized people in and out freely. It should also be equipped with a partial

leachate and gas management (Fauziah, 2010b). In addition, they need to tamp the soil to save space and provide stability for future use (Fauziah, 2010b). Controlled dumps allow more control in terms of management and landfill pollution emission with leachate treatment ponds, gas vents and others (Fauziah, 2010b).

Malaysia has upgraded the existing open dumps into controlled dumps with the installation of a gas vent and drainage system to ease environmental pollution in a more cost-effective method (Fauziah, 2010b). With these methods, possible dangers faced by workers and waste pickers in controlled dump is slightly reduced (Fauziah, 2010b). Examples of controlled dump in Malaysia are as follows:

a) Jeti Jelutong, Penang
b) Kuang, Selangor
c) Dengkil, Selangor

Record keeping is also crucial as it provides valuable information for reference and future planning (Fauziah, 2010b). Even though there are advantages offered by controlled dumps, sanitary landfill has been proven to be the best disposal site to date (Fauziah, 2010b).

2.3.3 Sanitary landfill

ISWA (1992) defined sanitary landfill as *"a landfill disposal practice where wastes are deposited in an orderly planned manner in accordance with conditions laid down by a regulatory authority"*. USEPA defined sanitary landfill *as "an engineered method of disposing of solid waste on land in a manner that protects the environment, by spreading the waste in thin layers, compacting it to the smallest practical volume and covering it with compacted soil by the end of each working day or at more frequent*

intervals if necessary" or a disposal facility which permanently deposits and stores non-hazardous solid waste for an exceeding period of six months. They are categorized into three main classes by USEPA according to the permitted types of wastes to be deposited into the facilities (Table 2.4).

Table 2.4: USEPA classification of sanitary landfill

Class	Waste type permitted
i.	All non-hazardous solid waste: Municipal solid waste, bulky waste, construction and demolition waste, vegetative waste, dry industry waste, animal and food processing waste and asbestos waste.
ii.	Specific category of non-hazardous waste: Dry industrial wastes, construction and demolition waste, vegetative waste, and asbestos containing waste.
iii.	Inert non-putrescible and non-hazardous waste: Bulky waste and vegetative waste

Source: Fauziah (2010b).

Sanitary landfilling method is considered to be most suitable means of final disposal of waste material (Kaseva and Mbuligwe, 2000). It was widely accepted and used due to its economic advantages (Renou *et al.*, 2008). Also, it minimizes the environmental impact and allows waste to decompose into stabilized material (Renou *et al.*, 2008). At the same time, ensuring that they pose no danger to the environment. Modern sanitary landfills differ significantly from the open dumps because the purpose of sanitary landfill is to make landfill as a safe area (TNSWEP, 2010). Sanitary landfills use high technology to avoid the possibility of dangers to the environment as leachate may

contaminate groundwater. Therefore, the sanitary landfill will be installed with layers of compacted clay and thick plastic cover at the bottom of the landfill. Additionally pipe will also be built to collect leachate and connect to a treatment center for detoxification purposes. Several wells surround the landfill site, providing means to monitor the quality of nearby groundwater. Each day, trash is brought to the landfill. It is unloaded, spread in a layer and covered with soil (Theodore and Elena, 2010). This soil cover eliminates odors and discourages scavengers such as birds and rodents. Pipes sunk vertically through the layers of trash and soil collects the methane gas that is produced naturally from decaying refuse. If not collected in pipes, this gas can form in pockets and become explosive. Some sites burn off this gas, while others use it to produce electricity. After a landfill has reached its capacity, it is sealed with an impermeable clay cap. A drainage ditch around the perimeter carries away rain water. Depending on the local geography former landfills may be converted into golf courses, airports, or wildlife refuges (TNSWEP, 2010).

Thus, in order to maintain cleanliness, sites must be fenced to prevent scavenging by people, animals, and off-hours dumpers (Theodore and Elena, 2010). It should be well-protected by having a well-paved and well-drained access roads. To avoid erosion the road should be planted with grass and trees and should be maintained (Theodore and Elena, 2010). The gas produced in landfill such as methane gas should also be recovered for use. The landfill should also be away from residential areas to avoid any discomfort or nuisance to residents.

Primarily in Asia, landfills form an integral part of waste management due its low cost (Lucas and Shreeve, 2000; Chong *et al.*, 2005). Each class of land filling offers different production pertaining to the cost, social and the environmental risks. Apparently, the

primary objective of sanitary landfilling is for safe long-term disposal of solid waste with minimal health impact, or environmental degradation. Planning of a landfill includes the consideration for the landfill. In Malaysia, there are eight active sanitary landfill as below:

a) Seelong, Johor
b) Tanjung Langsat, Johor
c) Kuching Utara, Sarawak
d) Sibuti, Sarawak
e) Kemunyang, Sarawak
f) Tanjung 12, Selangor
g) Bukit Tagar, Selangor,
h) Jeram, Selangor

Source: KPKT (2013).

Whereas secure landfill is predominately used for hazardous or toxic waste, sanitary landfill is more to MSW. It follows the principle of "controlled tipping", method of disposing solid waste without creating nuisance or hazard to public health. From the explanation above, we can conclude the advantage and disadvantage of each landfill as in Table 2.5.

Table 2.5: Advantage and Disadvantage by the Type of Landfill (Adapted from UNEP (1996)

Type	Advantages	Disadvantages
Open Dump	Easy access Extended lifetime Low initial cost Aerobic decomposition Access to scavengers Material recovery high	Environmental contamination Overuse, many noxious sites Unsightly, need remediation Ground on surface water contamination Encouraged vermin, pest and vectors to diseases Indiscriminate use Least efficient
Controlled Dump	Less risk of environmental contamination Allow long-term planning Low initial cost Easier rainfall runoff, reduced risk Moderate cost for maintenance Extended lifetime due to compaction Controlled access and use Material recovery lower	Less accessible Slight environmental contamination Decomposition slower Higher cost of compaction Higher cost for leachate and gas management
Sanitary Landfill	Minimized environmental risk Permit long-term planning Reduce risk from leachate and gas contamination Vector control Extended lifetime due to compaction Secure access with gate records Eliminate risk to scavengers Possible to harvest biogas	Access requires longer siting process High cost for construction Slower decomposition of waste High maintenance cost High cost for leachate and gas management No further material recovery activity
Secure landfill	Very minimal environmental risks Allows long-term planning with accurate information Prevent risk at site due to precautionary actions taken Eliminate risk to scavengers Prevent hazardous waste from contaminating the environment Pre-treated waste stop risk to environment i.e. no leachate etc.	High construction cost Minimum or almost absent of natural decomposition High waste pre-treatment cost High cost for maintenance No further material recovery activity

Source: Fauziah, (2010b).

2.4 Landfill hazard

Previously, waste management was progressively more mechanized, and these hazards have been contained from householder storage to collection through 'traditional' disposal route (landfill and mass burn incinerators). Obviously, household waste holds a diversity of materials and therefore potentially numerous hazards (Harrison and Hester, 2002). Thus, these hazards can be grouped into three main areas; They are chemical hazards, physical hazards, and biological hazards (Harrison and Hester, 2002).

2.4.1 Physical hazards

The key physical hazards faced by the respondents arose from the handling of waste materials, the ergonomic aspect of hand sorting, and contact with heavy machinery and vehicles. Occupational accidents in the waste management industry can be rather common, higher than national average for other professions (HSC, 2004), and often higher than the potential cases of adverse effects to the resident population investigated by epidemiological studies (HSC, 2004). Many landfills are also exposed to potential fires. Other than that, noise and vibration are present in landfills due to the active use of lorries and trucks movement (HSC, 2004).

Injuries are very likely to happen due to heavy lift. Heavy lifting usually results in back pain among the workers. One-third of users expect help with heavy lift which the employees reported to be a problem as it constitutes a risk of injury (HSC, 2004). Awkward working postures while picking and sorting waste causes the waste pickers to be exposed to a further higher risk of injury. Posture is also the most underestimated aspect of work among the waste pickers. Therefore, to reduce the risk of injury brought about by wrong posture, it is recommended that improvised tools should be used in the

process of picking and sorting waste.

2.4.2 Chemical hazards

Volatile organic compounds (VOCs) are produced when waste is degrading. These chemical hazards are attributed to landfill gas, leachate and production of odors (Harrison and Hester, 2002). Chemical hazards include vapors and residues from household hazardous waste (HHW), e.g. garden chemicals, wood preservatives, paints, cleaning materials and etc. Heavy metals are included in this category due to the possibility of exposure to cadmium and mercury from batteries in HHW (Harrison and Hester, 2002).

2.4.2.1 Landfill gas

The municipal waste consists of compounds such as chlorine, fluorine, sulfur, nitrogen and other elements. Those may result in the generation of toxic or corrosive gases such as hydrogen chloride, hydrogen fluoride, sulfur oxides and nitrogen oxides (Harrison and Hester, 2002).

All landfills will produce landfill gas containing biodegradable materials. Gases arising from biodegradation landfill consist of mainly hydrogen and carbon dioxide in the early stages followed by mainly methane, potent greenhouse gases (GHG) and carbon dioxide as a major component in a wide range and combination of concentration in the later stages. However, a wide range of other gases can be potentially formed and they may also be saturated with moisture (Harrison and Hester, 2002). Other minor components identified in landfill gas include, benzene, toluene, xylenes, hydrogen sulfide, organic esters and organic sulfur compounds. These landfill gases give landfill gas the characteristic of malodorous smell.

Landfill gas contains perhaps 55% methane and 45% CO_2 and more than 100 trace elements (Harrison and Hester, 2002). In theory one tonne of MSW will produce up to around 375 cubic meters (m^3) of landfill gas, with a calorific value of up to $20MJ^{-3}$ (Harrison and Hester, 2002). However, collection is challenging and even the most efficient landfill gas recovery systems capture no more than 70% (Harrison and Hester, 2002). Worldwide, emissions from landfill and open dumps have been estimated to contribute 6% of total global methane emissions (Harrison and Hester, 2002). As a general rule, a landfill containing one million tonnes (Mt) MSW disposed over ten years will generate 700 m^3 h^{-1} methane at peak (Harrison and Hester, 2002). The composition of gas within the waste changes quickly, with significant quantities of methane taking 3-12 months to be generated (Harrison and Hester, 2002).

Even though degradation is initially aerobic- yielding carbon dioxide and water, hydrogen and hydrogen sulfide may be produced at first (Harrison and Hester, 2002). Later, the process becomes anaerobic (Harrison and Hester, 2002). Landfill gas emissions have a number of pollutants of concern to human health, such as acrylonitrile, benzene and carbon tetrachloride (Harrison and Hester, 2002). Methyl mercury has also been measured at the working face of landfills. Landfill gas emissions contain VOCs that contribute to urban smog (Harrison and Hester, 2002).

In 1998, a study had been published in European Commission which concluded that in 1994 around 22 Mt of methane was emitted from man-made sources in Europe, including 8.2 Mt from landfills (Harrison and Hester, 2002). It has been expected that annual global production of methane from solid wastes will rise from around 55 million tonnes (Mt) in 1995 to 90 Mt in 2025 (Harrison and Hester, 2002).

Upon the atmospheric diffusion of the gaseous emission between the emission source

and the exposure point of receptor location (e.g., residential areas, schools, hospitals) exposure to trace landfill gas constituents is dependent (Harrison and Hester, 2002). According to Hester and Harisson (2002), the landfill gas and trace constituents become diluted as the gas mixes and disperses in the atmosphere the degree of dilution or, conversely, the level of exposure is a function of the rate of gaseous emissions into the atmosphere distance and orientation between the source of the gas and the receptor location and also on climatic conditions (wind speed and direction and atmospheric stability).

Depending on the special conditions at a given landfill site, there is a variety of source-receptor pathways that may potentially result in exposures to pollutant emissions from landfill sites. Inhalation of atmospheric landfill gas emissions is the only exposure pathway considered likely to be common to the majority of landfills (Harrison and Hester, 2002). It is also the pathway most consistent with epidemiological studies (Harrison and Hester, 2002).

The exposure risk assessment described would appear to indicate that emissions of trace gas constituent in landfill gas are not sufficiently high to represent a theoretical basis for adverse health effects in the vicinity of landfill sites (and certainly not at the distances indicated by the epidemiological studies) (Harrison and Hester, 2002). The dilutions that would occur between the waste mass and the landfill surface and in the atmosphere between the landfill surface and off site receptors would lessen concentrations below health-based criteria, with margins of safety of numerous orders of magnitude (Hester and Harisson, 2002). Even without engineered controls, the margin of safety seem to be sufficiently wide such that the whole conclusion is unlikely to be affected by the uncertainties associated with the approaches e.g. variation of emissions characteristic

within and between landfills, limitations in the toxicological data, synergistic effects, indirect pathways such as food chain uptake of gaseous compounds etc., except under exceptional circumstances.

One of the by-products generated by landfills is landfill gases. This resulted in the production of methane and other landfill gases including CO_2 and others. Table 2.6 list the typical composition of MSW landfill gas.

Gases produced by a landfill have a high heating value of 2048-14894 kJ/m^3 (Tchobanoglous *et al.*, 1993). The rate of landfill gas generation varies with the waste composition disposed into the landfill, the age of the landfill, the present of landfill liners, compaction of the waste, moisture content and others (Tchobanoglous *et al.*, 1993).

Table 2.6: Typical composition of MSW landfill gas

Component	Percentage (dry volume basis)
Methane	45-60
Carbon dioxide	40-60
Nitrogen	2-5
Oxygen	0.1-1.0
Sulphides, disulphides, mercaptans, etc.	0-1.0
Ammonia	0.1-1.0
Hydrogen	0-0.2
Carbon monoxide	0-0.2
Trace constituents	0.01-0.6

Source: Tchobanoglous *et al*. (1993).

2.4.2.2 Landfill leachate

Leachate represents the water which passes through the waste and water generated within the landfill site resulting in a fluid containing suspended solids, soluble components of the waste and products from the degradation of the waste by several

micro-organisms (Williams, 2005). The composition of leachate will depend on the heterogeneity and composition of the waste whether there is any industrial/ hazardous waste co-disposal, the stage of biodegradation reached by the waste moisture content and operational procedures.

A wide variety of toxic and polluting components are found in landfill leachates. A leachate management system would therefore be required to collect the leachate emanating from the mass of waste before making any discharge into sewer, water course, land and tidal water. The leachate management system is made up of a leachate drainage, collection and treatment system.

The two most significant components of leachate are organic chemicals and heavy metal. These may be conserved in the landfill in the short term, but can be mobilized and released through biochemical process (Harrison and Hester, 2002). Leachate is generated as a result of moisture entry into a landfill, either as rain, snow melt, run-on or as moisture in the waste itself (Harrison and Hester, 2002). Organic chemicals are present as soluble decomposition products (e.g. organic acids). They are also present as organic chemical (e.g. benzene, toluene, dioxins, halogenated aliphatic, pesticides, PCBs and organophosphates) discarded in the waste (Harrison and Hester, 2002). Many heave metals come from the non-regulated harmful waste fractions from households and business. Heavy metals are present in municipal solid waste. For example, municipal refuse may contain lead from lead based paints, mercury and cadmium from batteries, aluminium foil, lead plumbing and zinc sheets. Volatile metal compounds in the furnace of a municipal waste incinerator is a function of many factors, including volatility, combustion conditions and ash entrainment (Harrison and Hester, 2002). Heavy metals, such as mercury, chromium, nickel, lead, cadmium, copper and zinc, are often found in

landfill leachate (Harrison and Hester, 2002).

Groundwater supplies contamination due to the migration of leachate may occur and presently, there is no engineering design that can guarantee total containment (Harrison and Hester, 2002). The use of comprehensives environmental impact and risk analysis techniques are also demanded by policy-maker for quality control system (Harrison and Hester, 2002). Leachate management systems tend to be one of the three following types: onsite treatment (generally some form of aeration tank system), disposal to sewerage systems, or transport off site for treatment elsewhere (Harrison and Hester, 2002). A pressing concern is the environmental degradation that results from the poor practices of final disposition of solid waste. Leachate loaded with pollutants either escapes from the perimeter of a site or is collected in large pools in order to pump it back to the top of the dump; adhering to a recirculation model of leachate treatment (Harrison and Hester, 2002). The lack of a sound professional knowledge base, as well as, the absence of environmental supervision of the activities of the municipalities and the concessionaire, results in a waste management strategy that generates a number of new and complex difficulties.

2.4.2.3 Production of Odor

Odor can develop when solid wastes are stored for long periods of time. The development of odor is more significant in warm climates (Lehmann, 2007). Typically, the formation of odors results from the anaerobic decomposition of the readily decomposable organic components found in MSW. For example, under anaerobic (reducing) conditions, sulfate can be reduced to sulfide (S^{2-}), which subsequently combines with hydrogen to form H_2S (Tchobanoglous *et al.*, 1993). The sulfide ion can also combine with metal salts that may be present, such as iron, to form metal sulfides

(Tchobanoglous *et al.*, 1993). The black color of solid wastes that have undergone anaerobic decomposition in a landfill is primarily due to the formation of metal sulfides. If it is not for the formation of a variety of sulfides, odor problems at landfills could be quite significant. The biochemical reduction of an organic compound containing a sulfur radical can lead to the formation of malodorous compounds such as methyl mercaptan and amino butyric acid (Tchobanoglous *et al.*, 1993). The reduction of methionine, an amino acid, serves as an example (Tchobanoglous *et al.*, 1993).

$$CH_3SCH_2CH_2CH(NH_2)COOH \rightarrow CH_3SH + CH_3CH_2\,CH_2(NH_2)COOH$$

methionine — methyl mercaptan

amino butyric acid

The methyl mercaptan can be hydrolyzed biochemically to methyl alcohol and hydrogen sulfide:

$$CH_3SH + H_2O \rightarrow CH_4OH + H_2S$$

2.4.3 Biological hazards

Biological hazards cause the most concern in landfills. Collection and separation of household waste generates organic dusts. These include airborne bacteria and fungi (bio aerosols) and their cell wall components. Microbial cell wall components are significant constituents in organic dusts (Tchobanoglous *et al.*, 1993). Among the best known of these are bacterial endotoxins (a cell wall components in Gram-negative bacteria) (Harrison and Hester, 2002). Relationships between the amount of endotoxin in different environments and respiratory symptoms, spirometry changes and increased inflammatory markers have been reported (Harrison and Hester, 2002).

Dusts generated in waste facilities could also include airborne viruses. Viable or live microorganisms are implicated in infection and allergy, and pathogenic species such as *Aspergillus fumigates* are of some concern in composting (Harrison and Hester, 2002). Viable microorganisms are measured in colony forming unit (cfu); their viability is measured by their growth in a laboratory (Harrison and Hester, 2002). However, total numbers of microorganisms, including those alive and dead are causing particular concern in waste management. When microorganisms aerolised, their viability decreases. However, total number of cells can still cause airways irritation (Harrison and Hester, 2002). They are implicated in fever, flu-like symptoms, headaches, excessive tiredness and joint paints (termed 'Organic Dust Toxic Syndrome') and gastrointestinal problems (Harrison and Hester, 2002). Besides that, many waste pickers have encountered contaminated sharp edges while working in landfills, which are usually from domestic sources, e.g. diabetic users. Contaminated sharp edges refer to glass or metals that may lead to infection or disease. Of particular interest is tetanus, hepatitis (various strains) or less likely HIV.

Apart from that, there are also biological hazards brought about by the presence of carrier vector disease such as, flies, mice (Tchobanoglous *et al.,* 1993), mosquitoes, cockroaches, wild dogs and others. These animals do not only pose a risk in terms of spreading disease to the landfill workers and nearby residential areas, but they also interfere with work in the landfills.

2.5 Health impacts

The health issues associated with handling, treatment and disposal of waste whether in recovery, recycling activities, occupations in the waste management industry or by exposure to hazardous substances in the waste or to emissions from incinerators and

landfill sites, vermin, odors and noise) or indirectly (e.g. via ingestion of contaminated water, soil and food) must be addressed. Eduljee (1999) and Abdul and Grohmann (2011) have used a broadly similar risk assessment approach that incorporates a range of public health criteria, relating to both non-cancer and cancer effects. A risk assessment methodology was established by some researchers to examine the effects of household landfill emission via a number of possible exposure pathways, including inhalation of exposure to landfill gas, combustion emissions and dusts, as well as groundwater, surface water, consumption of water (in the case of water supplies contaminated with landfill leachate), the food chain (especially consumption of food contaminated with bacteria and viruses from land spread via sewage and manure, and food enriched with persistent organic chemicals that may be released from incinerators) and other pathways (Tchobanoglous *et al.*, 1993).

During composition process, gasses such as SO_2, NO_X, Dioxin, Sulphur, CO, Ammonia and other gasses will be released to the atmosphere. These gasses can enter the human body and will react with the chemicals found in the organs and some of the reactions it can be harmful to human. This will potentially lead to chronic diseases as shown in Table 2.7.

Others symptoms most regularly seen in the research are pulmonary disorders, organic dust-like symptoms, gastrointestinal problems, eye inflammation and irritation of the skin and upper airways (Harrison and Hester, 2002). The term ‘waste recycling worker syndrome’ has been suggested for the fever, influenza-like symptoms, upper airway irritation and eye inflammation often seen in waste handling (Harrison and Hester, 2002). However, there is limited information on the magnitude of risks and the causal factors of these problems, particularly in relation to different facilities and different

working tasks (Harrison and Hester, 2002)

Table 2.7: Chronic disease effect from landfill gaseous

Type of toxicity	**Type of organ damage**
Hepatotoxicity	Happens as a result of liver damage due to chemical action. Liver is an important organ that plays role for screening chemicals in the body.
Nephrotoxicity	Results from chemical damage the kidney
Pulmonary toxicity	The lung damage resulted from chemical and particular materials.
Neurotoxicity	Neurotoxicity happens when artificial or natural toxins known as neurotoxin that can change the function of normal activity of the nervous system. The disease will destroy neurons and cells of the most important in brain function and the other nerve. We can see the symptoms such as weakened limbs or numbness, memory loss, vision or thinking, headache, cognitive and behavior problems, poor attitude and sexual dysfunction.
Immunotoxicity	Immunotoxicity is a chemical that causes immune system failure in the event of exposure. When the immune system vulnerable to disease, the risk to cancer is very high. Immunotoxin can cause autoimmune disease (the immune system is over active) and begin to destroy the cells.
Chronic disease	Chronic disease occurs when the leachates contains heavy metals contaminating water sources and indirectly interfere with the human food chain.

Adapted: Robin (1993).

Besides, direct contact with waste will affect skin and cause blood infections. Eye and respiratory infections occurs when exposed to dust while operating the disposal site. For every 15 exposed operatives, five were asthmatic, but the rest were also exhibiting flu-like symptoms (possibly allergic alveolitis) eye and skin irritation, fatigue and occasional nausea (Harrison and Hester, 2002). Microbial decomposition activity and endotoxins were suspected as a cause to these effects. Inspections at the site indicated a proliferation of dust and food waste among ‘sortable’ materials; accumulated wet refuse was sometimes mixed with material for reuse (Harrison and Hester, 2002). Medical studies of operatives from the plant showed that eight operators became ill within seven months of starting (Harrison and Hester, 2002). In total, nine cases of occupational

disease among the original fifteen exposed operatives were reported (Harrison and Hester, 2002). Eight similar cases occurred between August 1986 and March 1987; the ninth case occurred in September 1988 (Harrison and Hester, 2002). The first two operators to become ill were involved in cleaning and hand sorting (Harrison and Hester, 2002). All symptoms begin with eye irritation and sore throats, followed by respiratory symptoms, including chest tightness and exercise-induced dyspnea (Harrison and Hester, 2002). Eight of nine cases were subsequently diagnosed with bronchial asthma (Harrison and Hester, 2002). Manas *et al.*, (2005) in their research, examined the respiratory and general health of workers employed in a municipal solid waste (MSW) disposal at an open landfill site in India. The result shows landfill workers had significantly higher prevalence of both upper and lower respiratory symptoms, and they suffered more often from diarrhea, fungal infection and ulceration of the skin, burning sensation in the extremities, tingling or numbness, transient loss of memory, and depression.

Dengue and malaria are both diseases spread by mosquitoes, while *squamous metaplasia* and *Sputum neutrophilia* are spread by flies (Howard, 2001). An extreme example is a plague outbreak in Surat, India in 1994 (Wilson *et al.*, 2006) which was caused by rat proliferation. The uncontrolled surge in rat population then increased the dispersal of Yersinia Pestis, a type of bacteria that causes plague (Adeyeba and Akinbo, 2002). Rats will also damage the electrical cable at the landfill. Urban solid wastes of developing countries contain high levels of intestinal parasites like *Ascaris lumbricoides*, *Entamoeba histolytica*, *Klebsiella*, and *Escherichia coli* along with a wide spectrum of human pathogens (Adeyeba and Akinbo, 2002). Therefore, garbage handling is associated with exposure to large quantities of bacteria, viruses, endotoxin, and helminthes eggs that could lead to an increased risk of gastrointestinal symptoms

and irritations of the eye and skin (Poulsen *et al.*, 1995). However the landfill site workers frequently get nausea and diarrhea, irritation of the eye and mucous membranes of the nose and upper airways, and skin problems (Poulsen *et al.*, 1995) affected from the pathogens in wastes (Straub *et al.*, 1993).

A number of recent epidemiological studies of UK and European landfill sites purport elevated risks of certain health effects, including birth defects and low birth weights (Harrison and Hester, 2002). Sever (1997) and Johnson (1999) highlighted an increased risk of birth defects and some cancers for the population living near landfill sites.

2.6 Type of recyclers

According to Taieba (2008), recovery and recycling occurs in three phases. In the first phase, waste generators separate the valuable waste and sell them to street hawkers. In the second phase, the waste pickers rummage through the wastes for recyclable material discarded by households and in the final phase, the waste pickers perform collection of recyclable material from the waste vehicles immediately after unloading at dumpsites. Waste picking activities form an economics on resource use, decrease the burden of waste disposal and contributes to environmental conservation (Seow *et al.*, 2006).

KPKT (2013) divides the recycling players into two components (Table 2.8) that are made up of recycling player 1 (RP1) which involved the street picker and scavenger and recycling player 2 (RP2) which involved the drop-off center, middleman, buy back center and recyclers.

Table 2.8: Recycling players in developing country

Recycling Player 1, RP 1	**Recycling Player 2, RP 2**
Door to door collector	Drop off centre
Street collector	Middleman
Waste collection workers	Junkshop who deals recyclables
Scavengers/waste pickers	Buy back centres
	Recycler (end user or buyers of recyclable materials)

Adapted from: KPKT (2013).

Waste pickers can be divided into two groups; those who work part time and those who work full time (Zainur *et al.*, 1994; Masocha, 2006; Seow, 2012). Part time waste picker is someone who loiters at the disposal sites or institutions for the greater part of the day but becomes active when municipal wastes are tipped. They also work as waste collector crew employed by municipal councils to retrieve recyclable materials from trucks during waste collection. They sell their recyclables material at a recycling center. They do this job because it can increase their income without care of wasting time to do waste collection (Medina, 1997b). Seow (2012) states that part time waste pickers have ordinary jobs such as security guards, operators, housewives, and cleaners but conduct their waste picking activities outside of their working hours. While others work there temporarily when unable to find employment in the labor market. In Johor, 72% are part time waste pickers (Seow and Indera, 2006) where 35% of them work in private sector, 24% works on their own, 11% in public sector and 4% in industrial sector (Seow *et al.*, 2006).

The second group comprises of waste pickers who spend the productive period of their lives at the landfill. Unlike the former group they spend hours digging for materials at one spot and move to the next when recyclables get exhausted (Masocha, 2006). In cities likes Cairo, Philippine and Mexico, the waste pickers work as a full time workers. They purchase various types of recyclables material from the residents. They work with

animal drawn carts, pushcarts, and pickup trucks to collect waste from households (Medina, 1997a). In India, full time waste pickers retrieve recyclable materials from garbage thrown into public places (e.g. footpaths, streets, and transfer stations) (Medina, 1997a). Waste picker also search for recyclable materials in rivers such as the Pasig River, Manila and the Chao Phraya River in Bangkok with the use of small boats (Medina, 1998). These recyclable materials increase especially during rainy season (Medina, 1998). In Johor, 15% of waste pickers work in landfills or dumpsites, 19% by the roadside, 21% in institutions and 45% freelancing, which means they collect waste anywhere (Seow, 2012). From literature review, most waste pickers in many countries do waste picking activity at municipal open dumps (Medina, 1997a). As many as 20 000 waste pickers live and work in Calcutta's municipal dumps, 12 000 in Manila and 15 000 in Mexico City (Medina, 1997a). In Malaysia, 15% of waste pickers work in landfills or dump sites, 19% by the road sites, 21% in institutions and 45% are freelancing (Seow, 2012). Most of them will spend 1 to 15 hours per day working (Seow, 2012).

Also, waste pickers scavenge recoverable materials from composting plants like in Monterrey, Mexico (Medina, 1998). There they will separate organic and non-organic wastes (Medina, 1998). This does not interfere with the composting work but help to reduce non-organic waste at the site (Medina, 1998). Waste picker in landfills perform various jobs and not limited to only finding recycled materials for sale. They also find recycled materials that can be used to build their houses on landfill such as construction and demolition waste (Afric, 2001).

2.7 Recyclers in developing country

The waste picking activity is widespread throughout the developing country and one of the most common phenomena in the Third World Countries (Seow *et al.*, 2006). In 1916, waste collection in Chicago was about 300 gram per capita a day as compared to 10 times of that today thanks to the involvement of waste pickers (Seow and Indera, 2006). About 2% of the populations from Asian and Latin American cities depend on waste picking to make a living (Medina, 2000). Most of informal recycling in Asian countries joined with formal system of MSWM via door to door collection to reduce waste that goes to landfill (Seow, 2005). This promotes win-win situation to both the formal and informal sectors. Nevertheless, the relationship between the formal and informal sectors remains uneasy; the official municipal perception of those who work in the informal waste sector is often negative (dirty, unclean).

China is estimated to have about 2 million waste picker involved in this field since the mid-1990s (Chen *et al.*, 2010a) followed by India which has one million waste pickers (Medina, 2000). Most waste pickers in developing countries can be found on the streets or in open dumps or landfill areas (JICA, 2002). In Tanzania, there are currently about 600 solid waste pickers who operate in 15 different collections (Kaseva and Gupta, 1996). In Zimbabwe, research done by Tevera and Masocha (2003) estimated that more than 3000 waste pickers work in dumpsite to earn their living. In Mexico City, about 600 waste pickers are registered and work at the dumpsite (Otoniel and Gerardo, 2003). In South Africa, the tasks are divided in such a way where young men would collect metal, while the women and older men would collect paper, glass, and plastics (Samson, 2009).

There are many researches done on informal recycling activities carried out by waste picker's cooperatives in developing country such as in Colombia (Medina, 1997c), in Brazil (Wells, 1995), Mexico (Medina, 1998) and the Philippines (Medina, 1998). Most of the papers discuss about waste pickers' cooperatives as these cooperatives not only increase the income of their members but also improve their working, living condition and promote grassroots development. The researches can be summarized accordingly in the consecutive paragraphs.

The most dynamic waste picker cooperative movement in the world today exists in Colombia (Medina, 1997c). This cooperative formed by a non-governmental organization since 1986 namely 'The Fundacion Social'. The foundation awards grants, where members can receive loans from the cooperative or scholarships to continue their studies, and have life and accident insurance (Medina, 1997c). The foundation also provides the cooperatives with legal, administrative and business assistance, as well as free consulting services (Medina, 1997c).

Waste picker cooperatives have formed a regional marketing association, which allows them to accumulate and sell recyclables material in higher prices than they were paid individually. In Colombia cooperative members report a higher standard of living; have improvements in self-esteem and self-reliance when they work together (Medina, 1997c).

In Brazil, Brazilian waste pickers have formed about 14 cooperatives from others places around Brazil to give support (Wells, 1995). Some of them have prepared an educational kit for waste pickers and NGOs to help them create waste picker cooperatives. Coopamare, one of the most successful waste picker cooperatives in Brazil, can collect up to 100 tons of recyclables in a month, half of what the recycling

program operated by the government and at a lower collection cost (Wells, 1995).

In Mexico, the most successful waste picker cooperatives started operation in 1975; it is known as The Sociedad de Seleccionadores de Materiales (SOCOSEMA). The local authorities have displaced the concession of recyclables material recovery at the dump from middlemen to the cooperative. The impact of the relatively simple transfer of power was inspiring. It increased the waste picker's incomes tenfold. The cooperative also receives donations of recyclable materials from the border assembly plants. Its members now enjoy higher incomes, participate in training courses and formal education programs sponsored by the cooperative, and have access to health care and legal protection (Medina, 1998).

In Philippines the formation of waste picker cooperatives has gained impetus by the creation of a non-governmental organization known as Women's Balikatan Movement (Medina, 1998). This NGO has created the Linis Ganda program which has a fixed route that which purchases source-separated recyclables at households and schools. Cooperatives can also obtain low-interest and collateral-free loans from the Philippine Department of Trade and Industry and from the Land Bank (Medina, 1998).

In India, the non-governmental organization (NGO) forms a cooperative for waste picker and incorporates them as waste collectors, or 'street beautifiers'. Waste pickers are provided with tricycle carts for collection activity. Payments made by residents (US $0.30 per month) are used to pay waste pickers' salaries and loans (Medina, 1998). This program has dignified waste picker activities, raised their earnings, reduced littering, increased refuse collection, and contribute to a cleaner urban environment (Medina, 1998).

During the reign of President Suharto in Indonesia, he announced about the good of the existence of waste picker in waste management system. They have enacted national legislation of waste pickers. The Private Banks have granted loans to waste picker cooperatives, and the national government has imposed a duty on imported waste materials, in an effort to increase waste pickers' income (Medina, 1998).

NGO-led programs supportive to waste pickers cause also exist in Cairo (Iskandar, 2003). Most waste pickers there are Coptic Christian minority, who has been active in waste picking activity since 1930s (Iskandar, 2003). In the 1970s, the Coptic Church helped establish an association representing the interests of the community. In 1981, a Zabbaleen Environment and Development Program were initiated, with funding from the Ford Foundation, the World Bank, Oxham and others (Iskandar, 2003).

2.8 Recyclers in Malaysia

Generally, there are many challenges for waste pickers in Malaysia. Not only do they risk their health and safety due to unhealthy and unsafe workplace condition, but their monthly income too is dependent on the global market price (Seow *et al.*, 2006). Although the knowledge of waste pickers and their work is present in Malaysia, the society rarely care or care to know about the impact waste pickers have on waste and waste management. The public continues to perceive the work carried out by them as an indication of poorness, lack of education and unhealthiness without regard to the reality that the pickers play an important role in the recycling activities in Malaysia (Seow et al., 2006).

A literature by Amzad and Chamhuri, (2001) stated that part time waste pickers need to be integrated, while full-time waste pickers need to be given more exposure to about the

rules they have to follow. The researcher also discussed the issue of price and types of collection that can increase waste picker's economy (Amzad and Chamhuri, 2001). Studies done by Zainur *et al.* (1994) also focus on the differences of part-time waste picker works with garbage truck in the Petaling district, Serdang and Puchong with full time waste picker works in Kelana Jaya, Sungai Besi, Bukit Kemunting and Puchong landfills. The research concluded that crews of garbage truck collector are more fortunate than full-time waste picker that retrieve materials at the landfill Zainur *et al.* (1994). Another study, Amzad *et al.*(2001) focuses on the health implications of full time and part time waste picker in Malaysia. From literature reviews, no waste pickers' cooperative can be found in Malaysia.

In Malaysia, the presence of part time waste picker is seen as encouraging. Part time waste pickers normally are in major cities due to the amount waste materials. This has driven poor people who are in the city to look for additional income to enable them to continue living in the city. This situation can be seen at the Central Market Kuala Lumpur. They continue to work hard scavenging, and emptying bins in the middle of the city while dodging glances and ignoring the perception the public has about their work.

Other than that, there are also waste picker who works full time at a landfill in Malaysia. Most of them are involved in this field due to lack of employment opportunities because of their educational constraint. Although there are Malaysians who are involved in this activity, full-time waste picker is dominated by foreigners such as Indonesians, Bangladeshis and others. Most researchers rarely focus on health and safety aspects of waste picker in landfills. Seow (2005) carried out a random survey of the challenges faces by street waste pickers, in institutions and landfills in the state of Johor. Among

the challenges discussed about waste picking activities and the socioeconomic situation of waste pickers are income, health problems and others.

Waste pickers are considered by some to be a hazard and a social problem since they may hinder smoothness of waste management at the dumpsites or they may be exposed to danger during the WM operations. Most of the Malaysian waste pickers do not know that they have to register with local authority to do waste picking (Seow *et al.*, 2006).

2.9 Socioeconomic aspects of informal recyclers

Socioeconomic of waste pickers differs from one place to another (Samson, 2009). Findings show that regardless of their background, waste pickers are often discriminated due to their work with garbage (Samson, 2009). Research by Kusumawati (2009) shown that 100% of waste pickers in Bandung are Muslims. In terms of the race 88% from Sundas, 4% is Javanese and 8% is unknown (Kusumawati, 2009). Marital status of respondents in Bandung city area revealed that 84% are married, 8% are widowed and 8% are single (Kusumawati, 2009). In Johor, 72% are married and 28% are single (Seow & Indera, 2006). While in Bandung the waste pickers are from 18-25 years old is 4%, 25-40 years old is 56%, 40-55 years old are 28%, and 55 years old and over are 6% (Kusumawati, 2009). Meanwhile, in Johor, 42% of the waste pickers are between the ages of 36-50 years old, 27% are between the ages of 51-65 years old, 5% are above 66 years old, 19% are between the ages of 21-35 years old, and 7% are less than 20 years old (Seow and Indera, 2006). The youngest found is 12 and the oldest is 80. Most of the waste pickers below the age of 20 are students looking for extra pocket money (Seow and Indera, 2006)). From the survey conducted by Kumar *et al*., (2001) it is found that there as many as 3965 children around the age of 12 years old involved in waste picking activities in the Kathmandu Valley and Dharan (Seow and Indera, 2006).

Kusumawati (2009) reported that there are also waste pickers with steady jobs where 19% of them are doing the waste picking due to their low income, 10% of the waste pickers do it because of the independence that comes with waste picking, 7% do it because they got fired by their employers, and 29% do it for other reasons (Kusumawati, 2009).

As for working hours for waste pickers in Johor, 34% work up to 8 hours per day, and 5% work 1 hour per day as a part time job where materials are accumulated slowly until they reach a certain acceptable volume for sale. 41% of waste pickers in Johor work 7 days, 33% work for 6 days, 13% work for 5 days, and 16% work for less than 5 days a week. (Seow *et al.*, 2006).

Seow and Indera (2006) found that in Johor Bahru are 75% of them are male and others are female. 25% of respondents are foreigners where most of them are from Indonesian and Nepal (Seow and Indera, 2006). 18% of the respondents never get formal educations, 37% of the respondents only have primary school education, and 41% of the respondents have secondary level education and 4% of the respondent have informal education (Seow and Indera, 2006). It can concluded that, most of them never get the high education in their life (Seow and Indera, 2006). The results also showed that waste pickers know that solid waste will harm the environment and can bring disease to human. At the same time, they also agreed that waste pickers have to be concerned about their safety issue at their work place. Most of them do not know that they have to register with local authority to get permit to do scavenging. They also lack the knowledge that scavenging activities can be hazardous to them (Seow and Indera, 2006).

According to Medina (2000), the waste pickers in Mexico City dumpsite have a life expectancy of 39 years, while the general population's is 67 years. Study by Semb (1982), in Port Said, Egypt, reported that the waste picker community had an infant mortality ratio 1:3; means one infant will die for every three births, which is higher than the rate of region. While in Cairo, one in four babies of waste picker will die before reaching their first year (Semb, 1982). Human contact with refuse implies a high risk for prevalence enteric and parasitic diseases. In Manila, more than 35 diseases have been identified within waste picker communities, including diarrhea, tetanus, hepatitis typhoid, fever, cholera, dysentery, tuberculosis, anthrax, poliomyelitis, skin disorders, pneumonia and malaria (Adan *et al.*, 1982). Infectious diseases can be spread either by direct contact with the waste, by animals such birds, goats and cows, or by air. About 81% of waste pickers in Johor have a good health while 12% have health problems. The common diseases recorded are hypertension, diabetes, asthma, heart disease, skin disease, kidney disease, cancer, HIV/AIDS and others (Seow and Indera, 2006). In the case of HIV/AIDS it is due to the fact that some of the waste pickers are drug addicts. Most waste pickers in Johor are sensitive when asked about their health information (Seow and Indera, 2006). Some of them consider skin diseases as a common disease because it is not life threatening. 48% of the respondents in Indonesia report frequent illness and poor health, 42% report of having uncertain level of health, 4% report of experiencing pain once a month, and another 4% report of experiencing pain 2-3 times a month (Kusumawati, 2009).

Waste pickers often live on or beside a landfill (for those without a house) in order to wait for the arrival of waste filled trucks. In Johor, 57% of waste pickers own houses, 31% rent the house and 24% staying on the landfill (Seow *et al.*, 2006). 90% of waste pickers in that state get clean water and electricity supply (Seow *et al.*, 2006). 52% of

them use telephone/ hand phone/ mobile phone (Seow *et al.*, 2006) 57% of them own motorcycle, 26% car, while other 31% have transports like bicycles and lorries (Seow and Indera, 2006).

In many countries, those who perform waste picking as an occupation are generally seen as having the lowest status in society (Blincow, 1986). In developing countries, the waste picking activities involve outcast and marginal groups such as the harijans people in India, non-Muslim people in Muslim countries (Christian minority in Cairo), gypsies, migrants and slaves in other countries (Furedy, 1984a; Medina, 1997b). Isolation as a part of social exclusion leads societies of waste pickers to develop their own habits, customs, beliefs and values (Berthier, 2003).

The commingled nature of waste reduces the possibility of retrieving the recyclables material and this lowers the price value due to the contamination of material intended for recycling (Berthier, 2003; Pasang *et al.*, 2007). Waste pickers' low incomes can often be explained by the low prices paid by middlemen (Medina, 1997a) especially in monopolistic markets which always exploit waste pickers grossly. The recycling network takes the form of a hierarchy. A monopolistic market exists where there is only one buyer (middlemen), in garbage collection. All waste pickers who do find recyclables materials are required to sell their proceeds to the middlemen. These middlemen usually have got a concession from landfill's management company to manage the sale and purchase activities. Monopolistic market is seen as a suppression of the waste pickers because the offer price is set by the middlemen itself. This price is far different from the recycling center outside the landfill. For example, waste pickers in some Colombian, Indian and Mexican cities can receive as low as 5% of the price industry pays (Holmes, 1984; Medina, 1997a). These concessions in actuality legitimize

monopolistic markets at the disposal sites, and in some cases, the exploitation of waste pickers. Table 2.9 show the average weekly income of waste pickers in Johor.

Table 2.9: Income rate generation of waste pickers in Johor

Income rate	**Frequency**
Less than RM 50 (USD 13.16)	178
RM 51- RM 100 (USD 13.17-USD 26.32)	15
RM 101- RM 150 (USD 26.33-USD 39.47)	1
RM 151- RM 200 (USD 39.48-USD 52.63)	4
RM 201 - RM 250 (USD 52.64-USD 65.79)	1

Adapted from Seow (2012).

Income generated and percentage of waste pickers in Johor are RM1-RM20 at 55%, RM21-RM40 at 32%, RM41-RM60 at 4%, RM61-RM80 at 4%, RM81-RM100 at 2% and more than RM 100 at 3% (Seow and Indera, 2006). The lowest income generated by waste picker was RM 1.11 and the highest was RM 250 in a day (Seow and Indera, 2006) Similarly, the result from Seow (2012) indicated that waste picking activity can generate the good income for most of the waste pickers. Findings by Kaseva and Gupta (1996) reported that even though there are those with low income, the average monthly income exceeded the official minimum wage (at the time of study) enabling them to support their families. Most of them earn less than RM50 (USD 13.16) per week.

2.9.1 Introduction to waste pickers

Waste picker refers to an individual who works as a waste collector either at the source (household level), at the process of collection, at temporary transfer points or at the disposal sites to retrieve valuable waste for reused, sold or given away (Zainur *et al.*,

1994; Medina, 2000; Seow and Indera, 2006). There are many different terms that can be used to refer to people that perform this job (Samson, 2009). These individuals are known as ‘scavengers’, ‘rag pickers’ or others based on the local language, their working place, and the materials they collect (Samson, 2009). These individual known as “Zabbaleen” in Cairo (Neamatalla, 1998) Mexican waste pickers are known as ‘pepenadores,’ while the term applies to the cardboard collectors is ‘cartoneros’, ‘buscabotes’ to the aluminum can collectors, and ‘traperos’ to rag collectors (Medina, 2000). The Colombians use the generic term ‘basuriegos’, while scrap metal collectors are known as ‘chatarreros’ (Ojeda-Benitez *et al.*, 2002), glass bottle collectors as ‘frasqueros’, and so forth (Medina, 2000). Some of these terms are seen as derogatory and have been rejected by many who do this work (Samson, 2009). The people who perform this job in many countries had debates about what to call themselves (Samson, 2009). Eventually it was agreed in First World Conference to use the term ‘reciclador’ in Spanish, ‘catador’ in Portuguese and ‘waste picker’ in English (Samson, 2009). So to respect the choice made by them, researcher therefore uses the term ‘waste picker’ in this research.

Emenda and Vilas (2010) found that most urban poor and marginalized social groups’ are involved in waste picking activity. Many of them live at the disposal sites. They make their daily living by separating, selling or reuse (Seow, 2012) the recyclables material as a source of income and frequently consume SW as part of their diet (Emenda and Vilas, 2010).

In most research, waste picking can be labeled as a family business. Every person in family involved in waste picking activity. For example research by Otoniel and Gerardo (2003) found that, a father and his oldest child would be at the ‘field’ searching for

materials and placing them in a large sack. Once the sack is full, they will go to a temporary ‘camp’ where the wife would take delivery of the load. She will proceed to categorise residues by material composition and make final separations placing materials in piles or medium-sized containers and ready to sell to middlemen. In Johor, 8% of waste pickers do their job with their spouse, 4% with their children, 3% with parents, 3%, with siblings, 3% with relatives and 4% with others (Seow and Indera, 2006).

From 1990 to 1998, many Asian countries have conducted the scavenging of recoverable materials, and this has increased the rate of recycling activities by 10-20% (Visvanathan *et al.*, 2004). Recent trends show that about two-thirds of the total labour force in the town directly or indirectly belongs to the informal waste picker which has eclipsed the formal waste management sector (Afric, 2001). Informal waste pickers are waste pickers who perform the scavenging of recoverable materials without permits or approval from the authority.

In Malaysia, the informal waste pickers are often regarded as invaders by municipality and they were never treated as an integral component in solid waste management (Zainur *et al.*, 1994). Although their work is cataloged as ‘disorganized’ and ‘informal’, the reality is that they possess very complex forms of organization. They are able to recover and recycle a large quantity of materials; so large are these quantities that they surpass those obtained in developed countries. This fact demonstrates the necessity to include these groups in the decision-making process with respect to the handling of SW.

The great numbers of waste picker is explained that they opted for waste picking due to unemployment, low-skill occupation with relatively free entry and low capital investment (Blincow, 1986; Tevera, 1994; Waite, 1995; Kaseva and Gupta, 1996). On

the one hand, these groups are extremely variable, which makes it very difficult to establish any permanent work programs and to monitor their activities. They are increasingly at risk of being exploited and manipulated by government leaders (Otoniel and Gerardo, 2003).

It is difficult to quantify the total contribution of the waste pickers to urban waste management (Seow, 2012) because this sector inherently implies a lack of official statistical data and the data therefore the total contribution remains uncertain. For example Wilson *et al.*, (2006) reported that recycling informal sector found that recycling rates by waste pickers can be quite high typically within the range of 20% to 50%. For Mexico, waste pickers are estimated to remove 10% of the municipal waste (Bartone *et al.*, 1991). In Banglore, India the waste pickers is claimed to prevent 15% of the municipal waste from going to dumpsites (Baud and Schenk, 1994). In Karachi, the waste pickers reduce municipal waste collection by 10% (Ali *et al.*, 1993). Based on the World Bank estimation, 1-2% of the population of big cities is supported directly or indirectly by the refuse generated by the upper 10-20% of the population (Hogland and Marques, 2000). It is crucial to have the value of their work quantified and supported (Samson, 2009).

2.9.2 Type of material recovered by waste pickers

The compositions of waste differ significantly from one city to another. It depends on climate, culture, living standards, and citizens' dietary habits. While the price of recyclable materials depend on their quality (Seow and Indera, 2006). The existence of waste pickers depends upon the nature and the materials they looked for. Waste pickers not only collect recyclable materials for selling but they also keep some product for their own-use (Seow, 2012). Commonly waste collected are sorted into different

categories depending upon the available market including paper, cardboard, textiles, leather, aluminium, can, plastics, glass bottles, ferrous metal, copper, lead, iron, wood and organics (Kaseva and Gupta, 1996; Medina, 1997c; Seow, 2012). In developed countries, recovery of material from solid wastes stream are affected more systematically at central collection and processing stations (Kaseva and Gupta, 1996). For waste pickers in Johor, cardboards, aluminium cans and glass bottles are the major recyclable materials that can generate their income (Seow *et al.*, 2006). They also find metal because of their high price (Seow and Indera, 2006) and others material such as radio and television (Seow and Indera, 2006).

Through waste picker, considerable type of waste materials that can be recycled (Haan *et al.*, 1998) are routinely removed from municipal solid waste streams in most cities in the developing world, such as Gaborone (Tevera, 1991), Dar es Salaam (Yhdego, 1991), Calcutta (Furedy, 1884) and Mexico City (Medina, 2003). Organic waste can also have monetary, nutrient and energy value, as they are used as livestock fodder, soil improvers and fuel (Dulac, 2001). The waste pickers separate the waste; feed the edible portion to pigs; sell pig droppings and human excrement to farmers as fertilizer; and sell scrap metal, glass, paper and plastics to middlemen (Medina, 1997b). They are also involved in digging up reusable building materials such as concrete stones and bricks. Medina (1997b) observed that some of the retrieved materials such as cement bricks require no processing before they are sold while others such as concrete slabs and sand are broken using improvised low-cost hammers to recover stones and sieved, respectively, before being marketed. Most of the waste pickers operate individually with specialization in recovered materials being dictated by component availability in delivered waste. Some degree of specialization between sexes was observed with women dealing mostly with wood, coconut husks and food items, while men concentrated mostly on leather, bottles,

metal scraps and packaging materials for four materials, i.e. papers, metals, plastics and glass (1997b). Table 2.10 shows the recyclable materials normally retrieved by waste pickers.

Table 2.10: Materials from MSW that have been recovered for recycling

Recyclable material	**Types of materials of uses**
Aluminium	Soft drink and beer cans
Paper	
Old newspaper	Newsstand and home-delivered newspaper
Corrugated cardboard	Bulk packaging; largest single source of waste paper for recycling
High-grade paper	Computer paper, white ledger paper, and trim cuttings
Mixed paper	Various mixtures of clean paper, including newsprint, magazines, and white and coloured long-fiber paper.
Plastics	
Polyethylene terephthalate (PETE/1)	Soft drink bottles, salad dressing and vegetable oil bottles; photographic film
High-density polyethylene (HDPE/2)	Milk jugs, water containers, detergent and cooking oil bottles
Polyvinyl chloride (PVC/3)	Home landscaping irrigation piping, some food packaging, and bottles
Low-density polyethylene (LDPE/4)	Thin-film packaging and wraps; dry cleaning film bags; other film material
Polypropylene (PP/5)	Closures and labels for bottles and containers, battery casings, bread and cheese wraps, cereal box liners
Polystyrene (PS/6)	Packaging for eletronic and electrical components, foam cups, fast food containers, tableware, and microwave plates
Multilayer and other (7)	Multilayered packaging, ketchup and mustard bottles
Mixed plastics	Various combinations of the above products
Glass	Clear, green, and brown glass bottles and containers
Ferrous metal	Tin cans, white goods, and other metals
Nonferrous metal	Aluminium, copper, lead, etc
Yard wastes, collected separately	Used to prepare compost; biomass fuel; intermediate landfill cover
Organic fraction of MSW	Used to prepare compost for soil applications; compost for use as intermediate landfill cover; methane; ethanol and other organic compounds; refused-derived fuel (RDF)

Construction and demolition wastes	Soil, asphalt, concrete, wood, drywall, shingles, metals
Wood	Packing materials, pallets, scraps, and used wood from construction projects
Waste oil	Automobile and truck oil; reprocessed for reuse or fuel
Tires	Automobile and truck tires; road building material; fuel
Lead-acid batteries	Automobile and truck batteries; shredded to recover individual components such as acid, plastic, and lead
Household batteries	Potential recovery of zinc, mercury, and silver

Source: Tchobanoglous *et al.,* (1993).

2.9.3 Problems faced by waste picker

Waste picker have their own problems and need to fight for their rights especially on privatization issues such as in India, Peru, Brazil, Colombia and Egypt. The problems exist with the introduction of sanitary landfills which denies the role of waste pickers (Samson, 2009). Waste pickers were negatively affected by privatization that they make different choices on how to respond and what demands to make (Samson, 2009). Each of these processes is profoundly political and it is crucial that all parties consider the implications of the approaches adopted within each particular context (Samson, 2009). In other places, the practice of informal collection is widespread but still controversial. For example in Nigerian cities, the activities of informal collectors are illegal, because they often separate what they want and dump the residual wastes indiscriminately. This results in persecution of the entire informal sector (Imam *et al.*, 2008). Besides that, health and safety risks are also associated with waste pickers. These risks originate from the nature of the waste and the rudimentary process employed to collect, process, recycle and dispose it (Medina, 2000).

From the literature review, most waste pickers are cynically viewed in the society. They face multiple hazards and problems such as dirt, disease, squalor, and perceived as a nuisance, a symbol of backwardness, and even as criminals. In Colombia, some paramilitary groups have conducted 'social cleansing' campaign (Medina, 2000). They consider waste pickers as 'disposable' to be harassed and expelled from certain neighborhoods and towns (Medina, 2000). The most tragic event was when 40 corpses of waste pickers were found with their organs harvested, in 1992. The rest of their bodies were sold to the university to be dissected by medical students. Approximately 2000 'disposable' individuals had been killed by the end of 1994 in Colombia (Medina, 2000).

Transportation used by the waste picker when searching for recycled materials are mostly manual-based transport such push carts, wheel barrows, tricycles, donkey carts, horse carts, or pick-up trucks (Masocha, 2004b; Imam *et al.*, 2008). The basic equipment used includes tools such as picks, hand-rakes, simple hooks, shovels and iron sorting rods. They provide service in areas not served by municipal authorities (Kaseva and Gupta, 1996; Masocha, 2004a; Imam *et al.*, 2008; Seow, 2012). Some of them also pick up wastes with their bare hands (Seow, 2012). Waste pickers normally have no vocational training or access to appropriate equipment and do not normally have alternative employment opportunities in the formal sector. The waste pickers and other informal sector recyclers generally sell their recovered materials to middlemen (Imam *et al.*, 2008). They have complained about 'unscrupulous' buyers often taking advantage of their unprivileged position and buy quantities estimated to constitute a cubic metre, when in reality they get more than they bargain for and this represents a considerable loss of potential revenue (Masocha, 2004a). Wilson et al (2006) has examined in detail the role of the informal sector in waste management in developing country cities,

although relatively little data are available on the effectiveness and overall contribution of informal sector recycling.

2.10 Public policy towards waste pickers

Public policy is based on each country's perception of waste picker activity. The currently practiced policy is intended to reduce health and environmental risks associated with waste management and disposal. Authorities in developing countries display a wide variety of policies that deal with waste pickers. Those policies can be classified into the following (Medina, 1997a).

2.10.1 Repression

Most developing countries adopted a policy of repression. They consider the waste pickers as inhuman, a symbol of backwardness, and a source of embarrassment and shame for the city or country. The localities in Colombia, India, and The Philippine declared waste picker activity as illegal (Keyes, 1974; Furedy, 1984a). While in Cairo, authorities banned transportations such as donkey carts used by the waste pickers for scavenging activity (Meyer, 1987). Restrictions and a hostile attitude towards waste pickers typify repressive policies.

2.10.2 Neglect

This policy is one in which the authority neglect waste picking activity. They don’t care for operations performed by waste pickers, and do not help with financial state of the waste pickers or their health. This policy is common in African countries (Medina, 2000).

2.10.3 Collusion

There are also official governments creating two-way relations with the chief of waste pickers particularly to give profit for both parties. The government provides area and keeps the garbage collection for waste picker while waste picker will pay a sum of money to them. Mexico City illustrates a situation of collusion between authorities and waste picker leaders (Medina, 2000). Over the last five decades, a complex structure developed, involving legal and illegal relationships between dump waste pickers and the local bosses normally middlemen, industry, or local authorities (Medina, 2000). Some of the illegal relationships include the payment of bribes to government officials by the local bosses to ignore the local bosses' abuse of power; the tips that refuse collectors demand from small industries and some households to pick up their waste and the 'sale' of refuse collection routes in wealthy neighborhoods (Medina, 2000). Thus, the Mexican government gets bribes and political support from waste pickers, and waste pickers obtain legitimacy and stability in their operations (Medina, 2000).

2.10.4 Stimulation

As a result of the failure of some of the technology that was introduced by the Americans and Europeans, the policy on the existence of waste pickers in the waste management system changed. They realized the advantages of the existence of waste picker in the economy, society, and environment. Observing the hardship waste picker faced while in the landfills, they authority has banned activities there, leading to the lowering of their income (Medina, 1997b). Street waste pickers are sometimes assaulted by street gangs and persecuted by police (Medina, 1997b). In conclusion, the landfill ban had a serious negative impact on waste pickers' income and standard of living. Similar experiences have been observed in other Asian and Latin American countries

(Medina, 1997b). Scavenging tends to persist despite efforts to eradicate it. Therefore, a more humane and socially desirable response should be in place; One that helps waste pickers to achieve a better existence. They should provide assistance, particularly in terms of self-management while making recommendations to improve the income and living conditions (Medina, 1997b).

To date, there are many studies on waste recovery (Furedy, 1884; Zinyama and Tevera, 1993) which were undertaken against a backdrop of increasing urban poverty. Some of the studies (e.g.Birkbeck, 1979; Blincow, 1986; Iskandar, 2003) focused on how the urban poor are eking out a living at the periphery of the formal economy while others (e.g.Furedy, 1884; Meyer, 1987; Tevera, 1991) have provided socio-economic profiles of waste harvesters. The works of many scholars such as Zinyama and Tevera (1993) and Velma and Masocha (2003) showed that in most developing countries, poverty compels the poor to engage in waste harvesting activities despite the stigma, social disdain and health risks associated with the practice (Masocha, 2003).

Incorporating the informal collectors into solid waste management system can be a method of control in illegal dumping and manage the operation of waste collecting system as well. For example, if incentives were created for the informal collectors to bring the recyclable materials they collected to transfer stations, local authorities then would be responsible for its transport to the final disposal sites. This view is difficult to substantiate since recycling is done mainly by the informal private sector, especially scavengers, itinerant buyers, and garbage truck helpers (Sicular, 1992; WorldBank, 2003; Pasang *et al.*, 2007)). So far waste picker plays an important role in waste management. They are able reduce of as much as 15% of the total waste generated daily (Sicular, 1992; Trisyanti, 2004).

CHAPTER 3

METHODOLOGY

3.0 Methodology

3.1 Introduction

The methodology adopted in this study involved the execution of a number of tasks namely; review of related literature, definition of the problem, clarification of the study objectives, design of survey questionnaires, data collection, processing of the survey data, analysing and finally evaluating the results.

3.2 Observation

Observation was one of the methods of data collection used to corroborate the responses of the respondents (Maxwell, 2005). Site visit was done about six to seven times to each landfill during the course of this study. During the site visit, the working activities of the waste pickers were observed to identify the problem they encounter. The total number of waste pickers present on the landfills, and the method of financial transaction used between the waste pickers and their middlemen were noted. Some data, like the living condition of the waste pickers, and the corroboration of some of the reports made by them, are gained indirectly through observation made on the situation, body language, and facial expression of the respondents. Proving to be a reliable method of authenticating the feedbacks gotten from the respondents, the researchers are finally able to complete this study successfully.

3.3 Socio-Economic Survey

Socio-economic survey is a main method for this research. Mohd (1991) stated that the questionnaire can be a replacement of researcher. The questionnaire can be distributed quickly, easily and covers a wide area. Thus, it saves time and cost of researcher (Mohd, 1991). The survey was conducted with 30 respondents in each study area using a set of questionnaires (Appendix 1.0) to gather information on waste picker's socio-economic and their perception on the environmental awareness issues. Questionnaires were administered randomly to waste picker who recover materials from three types of landfill: (a) the sanitary landfill, (b) the non-sanitary landfill and (c) the open dump landfill. Random sampling was applied to prevent biased results.

Fifty-seven questions were prepared in the questionnaires. The respondents were interviewed in an informal manner using questionnaire survey. The questionnaire sought information on the following:

i. Part A: Demographic Characteristic

Five questions about the background information were asked in part A to get the demographic characteristics of waste pickers.

ii. Part B: Socio-economic status

In part B, 22 questions were asked. The questions included education, type of house, type of materials they recovered and income derived from sale of obtained materials, etc.

iii. Part C: Occupational, Safety and Health

Fourteen questions about occupational safety and health were asked in part C. The questions included their working condition at the landfills, insect and animal existence, and health and safety control measures. The questions in this part were asked to know the problems faced by the waste pickers during their waste picking activity in the landfill.

iv. Part D: Awareness Towards 3R Activities

Part D consists of 16 questions. The questions asked were about the waste picker's awareness towards the environmental terms and their 3R activities. The purpose of this part is to know the environmental awareness among the waste pickers.

A structured, yet simple questionnaire was designed, to collect data of waste pickers' opinion on the problems at the landfills and the relevant criteria needed to work at the landfills. The questionnaire included a 'Yes' or 'No' question to find out whether the participant knew of any problems occurring in the landfill in general. If the answer was 'Yes' the person was asked to mention two or three problems. These questions are required to fulfill the objectives.

Responses obtained were computed using Statistical Package for Social Sciences (SPSS) to derive the frequencies of particular socio-economic factors.

3.4 Interview

Since the study is empirical and descriptive in nature, the respondents of the study were interviewed to ensure adequate inquiry and as a supporting method. The interview had done just like an informal conversation with having a set of questions (Appendix 2.0).

Accordingly, the case was taken to make questions in simple and clear language, and also free from personal bias. Open ended questions with some possible answers were adopted whenever needed with possibility of adding responses given by the respondents.

Face-to-face interviews were conducted at dumpsites. A short but focused questionnaire was used to ensure that the interview only did minimal disruption to recuperation work. Apart from the waste pickers, a middleman who employs their assistants was also interviewed. The middleman buys recovered material for resale to recycling companies located in Selangor. No questionnaire was prepared solely to cater for them and the interview was therefore informal. It also helps the researcher to ask more questions that arise at the moment pertaining to the study which have not been included in the schedule. The interview sought information on the types of material they bought, the products manufactured and earnings that are derived from this business.

However, the main interest of present work seeks to collect facts on working and living standard of waste pickers. Therefore, while interviewing, every attempt was made to put up the questions at appropriate point of time keeping the interest of the respondents, their spoken language and time obtained in advance for interview.

3.5 Compilation of Background Information

Background information including population data, racial composition, and the socio-economic level of waste pickers was obtained from survey and interviews with the respondents, local authorities and relevant authorities including the Statistical Department of Malaysia.

3.6 Study Area

In Selangor, there are eight dumping sites as in Table 3.1 that are still operational while 14 dumping sites have been closed, giving the total of 22 dumping sites. Out of the eight operational sites, three are sanitary landfills, and two are inert landfills. Three landfills were chosen to represent a sanitary, a non-sanitary landfill and an open dump. Hence Jeram sanitary landfill, Dengkil non sanitary landfill and Bukit Beruntung open dump were selected respectively.

Table 3.1: Locations of landfill in Selangor

Area	**Landfill**	**Level of landfill (Operation)**
Hulu Selangor	Kalumpang	Non-Sanitary
Hulu Selangor	Bkt Beruntung	Non-Sanitary
Kuala Langat	Tanjung Dua Belas	Sanitary
Kuala Lumpur	Bukit Tagar	Sanitary
Kuala Selangor	Jeram	Sanitary
Sabak Bernam	Jalan Panchang Bedena	Non-Sanitary
Selayang	Kuang	Non-Sanitary (Inert Landfill)
Sepang	Dengkil	Non-Sanitary (Inert Landfill)

Source: KPKT (2011).

3.6.1 Jeram Sanitary Landfill

Jeram Sanitary Landfill whose jurisdiction is held by the Selangor State Government is managed by World Wide Landfill (P) Ltd. These sanitary landfills are well planned and engineered to prevent the risk of environmental contaminations. The technologies applied ensure that pollutants generated by these landfills will not contaminate the environment as long as the monitoring and preventive actions are taken care off. On the other hand, the remaining landfills pose threat to the environment due to the lack of appropriate measures to curb pollution. Figure 3.1 shows the map of Jeram sanitary

landfill while Plate 3.1 shows the entrance to Jeram sanitary landfill.

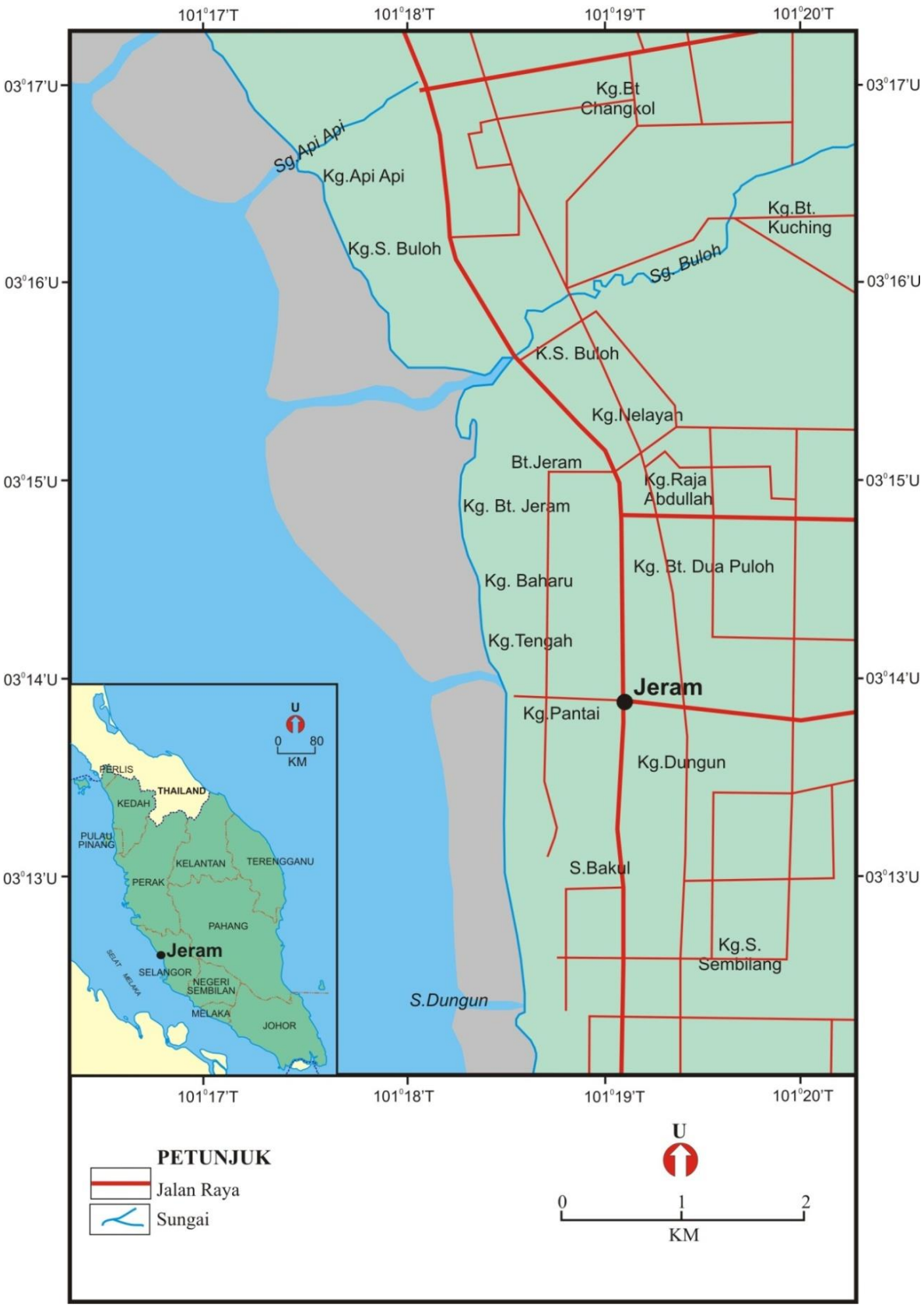

Figure 3.1: Map of Jeram Sanitary Landfill

Plate 3.1: Jeram Sanitary Landfill (front view of entrance)

3.6.2 Dengkil Non-Sanitary Landfill

Dengkil Non-Sanitary Landfill was located in Timah Langat, Mukim Dengkil, and Sepang. The jurisdiction is held by the Selangor State Government and managed by WL Environment Sdn. Bhd. This sanitary landfill is included in Timah Langat old mining area. Most of the waste goes that in the Dengkil non-sanitary landfill are garden wastes. Figure 3.2 shows the map of Dengkil non-sanitary landfill meanwhile Plate 3.1 shows the front view of Dengkil non-sanitary landfill entrance

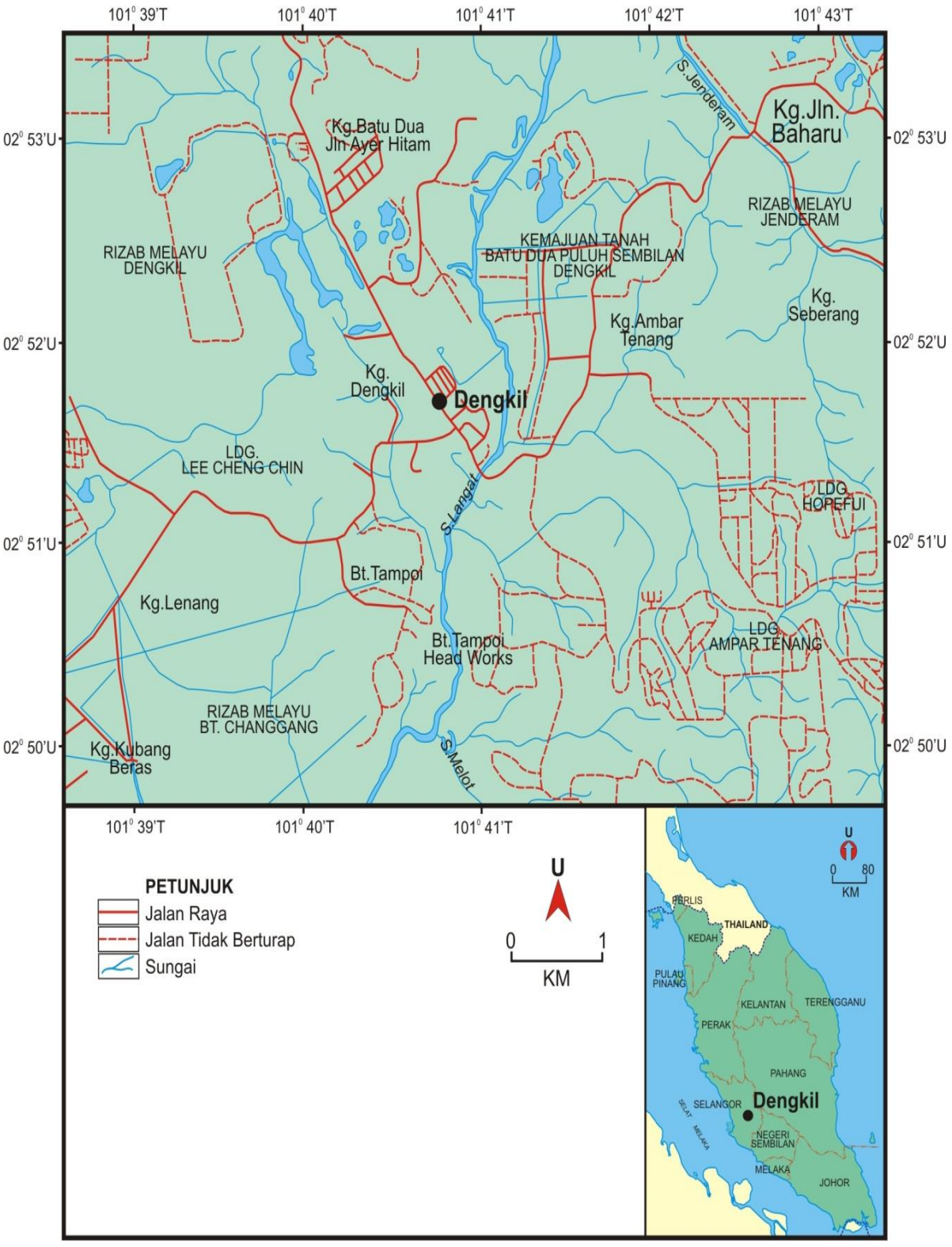

Figure 3.2: Map of Dengkil Non-Sanitary Landfill

Plate 3.2: Dengkil non-Sanitary Landfill (front view from entrance).

3.6.3 Bukit Beruntung Open Dump

Bukit Beruntung landfill, which is visible from the North-South Highways (PLUS), receives approximately 80 tons of waste daily. The depression in the hilly area allows the expansion of the disposal site. Lack of enforcement by local municipality resulted in illegal dumping of MSW along the road to the landfill site. The landfill lacks any facilities that it falls under Class I. Waste picking activities is very active in the landfill where recyclable materials are recovered. Figure 3.3 shows the map of Bukit Beruntung Open Dump and Plate 3.3 shows the entrance to Bukit Beruntung Open Dump.

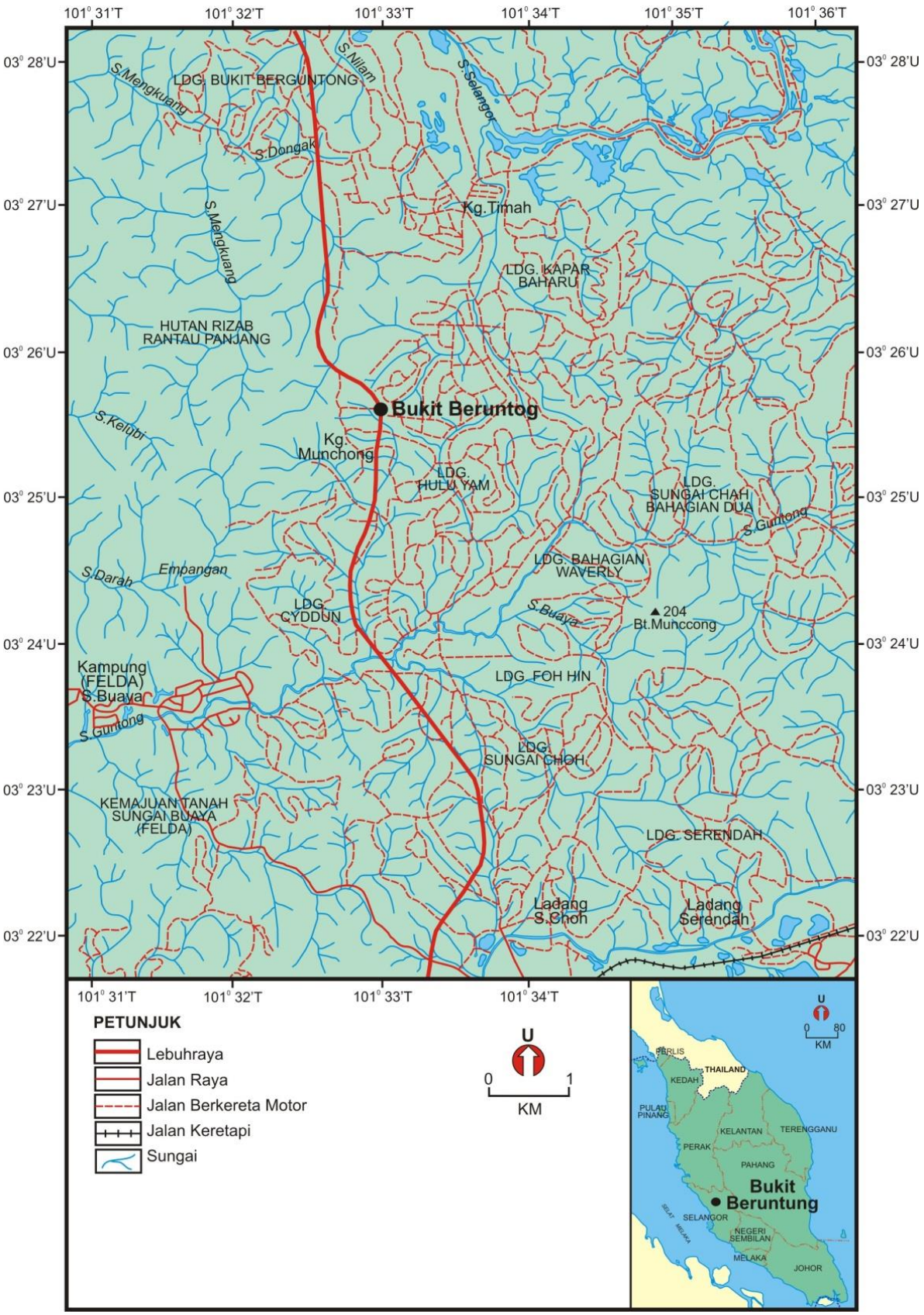

Figure 3.3: Map of Bukit Beruntung Open Dumping

Plate 3.3: Bukit Beruntung Open dumping (front view from entrance).

The landfills in Dengkil and Jeram are managed by a private company (Worldwide Holdings) meanwhile Bukit Beruntung landfill is managed by the local authority (Hulu Selangor District Council). Details including landfill status, waste composition disposed in each landfills, daily average of waste disposed into each landfill and others are summarized in Table 3.2.

Table 3.2: General conditions of the landfill studied

	Jeram	Dengkil	Bukit Beruntung
Landfill type	Sanitary	Non-sanitary	Open dumping
Location	Tuan Mee Estate, Jeram, Kuala Selangor	Timah Langat, Mukim Dengkil, Sepang	Along the North-South Expressway
Operator	Worldwide Landfill Sdn Bhd	Worldwide Landfill Sdn Bhd	Hulu Selangor District Council
Current Status	Operation	Operation	Operation
Design Capacity	1250 tonnes per day	4000 tonnes per day	400 tonnes per day
Design Lifespan	16 years	20 years	11 years
Area	160 acres	145 acres	20 acres
Concession	25 years with State Government of Selangor	25 years with State Government of Selangor	Five years with State Government of Selangor
Date of commencement	1st Jan 2007	1st Dec 2004	2007
Waste composition	Domestic Waste (95%) Others (5%)	57.87% garden waste 0.11% Tyre 17.42% construction waste 24.60% others waste	Household Commercial Industrial
Customers / Areas covered	MBSA, MBPJ, MP Subang Jaya, MP Klang, MD Hulu Selangor, MP Ampang, Private waste collector	MBSA, MBPJ, MP Subang Jaya, MP Sepang, MP Kajang, MP Ampang, Private waste collector	Bandar Baru Bukit Beruntung, Bukit Sentosa, Serendah, Sungai Choh
Daily average of waste disposed (tonnage)	2000 and above		100 to120

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Part A: Demographic

The study delves into the socio-economic of waste pickers and their environmental awareness. Generally, the respondents were from nine years old to 45 years old with the majority being males. Table 4.1 summarizes the background information of the respondents in each study area based on the majority group of the relevant categories.

Table 4.1: Brief description of the majority group among respondents of the survey

Area Studied	Jeram sanitary landfill	Dengkil non sanitary landfill	Bukit Beruntung open dumping
Gender	Male	Male	Male
Age	> 25 years	> 32 years	> 32 years
Nationality	Indonesia	Indonesia	Malaysia
Marital status	Married	Married	Married
Religion	Islam	Islam	Islam
Race	Madura	Madura	Malaysian indigenous people
Income	RM 751 - RM 1000	RM 251 - RM 500	RM 751 - RM 1000
Education level	Primary education	Primary education	Secondary education

4.1.1 Gender of waste pickers in each landfill

In this study, the waste pickers' genders are also taken into consideration as waste pickers of both sexes are present in all landfills studied. Plate 4.1 shows the typical scenarios in the landfill. The percentage of male respondents in Jeram is 56.7%, 73.3% in Dengkil, and 76.7% in Bukit Beruntung. Meanwhile the percentage of female respondents in Jeram was 43.3%, 26.7% in Dengkil and 23.3% in Bukit Beruntung. The most dominant gender in all landfills is male.

Plate 4.1: The waste pickers comprised of both male and female gender were found at Jeram landfill.

The distribution by landfill is shown in Figure 4.1. Men are viewed more suitable to do the work of collecting waste in landfills than females, because they would have better ability to withstand the pressures in landfills and are able to do heavy work. This is the reason behind the larger number of male waste pickers than female. However, an interesting observation was recorded in Jeram where both genders are almost similar in percentage. This is because most of the waste pickers in Jeram bring their spouses to work in the same landfill. While in Dengkil and Bukit Beruntung such situation did not occur. Most of them especially in Bukit Beruntung dump were unmarried males. The results obtained at Bukit Beruntung and Dengkil was very similar to the study by Seow (2012) in Johor, where the percentage of male waste pickers were 75% while the rest were females.

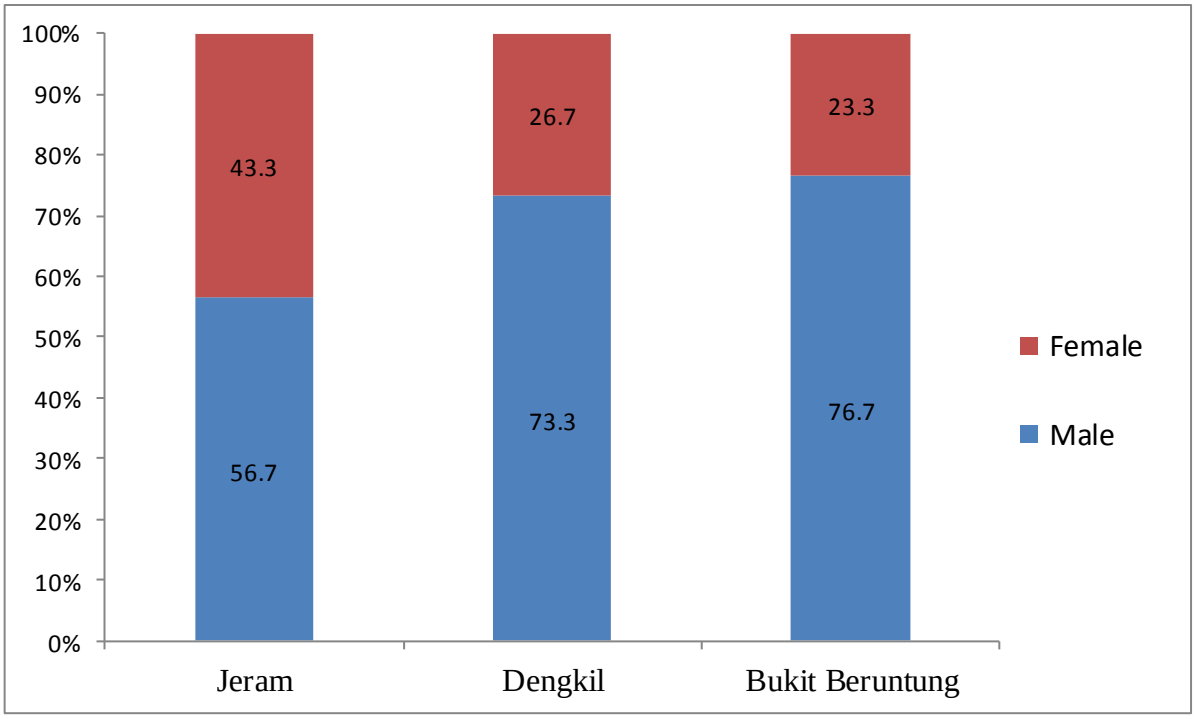

Figure 4.1: Percentage of waste pickers' gender in each landfill

4.1.2 The percentage of waste pickers' age for each landfill

Figure 4.2 shows that Jeram and Dengkil waste pickers consisted of waste pickers aged between 19 years and above only. Generally most of the waste pickers were of the age 25 and above. There are non-Malaysians that do not abide to the legal minimum age limit allowed to work in Malaysia (18 years old and above). On the other hand, Bukit Beruntung's waste pickers are of a variety of age ranging from children, youth to adults. Most of the children involved in waste picking in Bukit Beruntung are school drop-outs. School children are also involved in this activity. They use their free time after school and during the weekends to retrieve recyclables. Most of them work to supplement their family income

In Jeram and Dengkil disposal sites, the management restricts the age of employees who work in the landfill ensuring that those who work were over 18 years old. Most of them

are foreigners who come to Malaysia and have no working experience or do not have the skills to work in other sectors (especially those between 19-24 years).

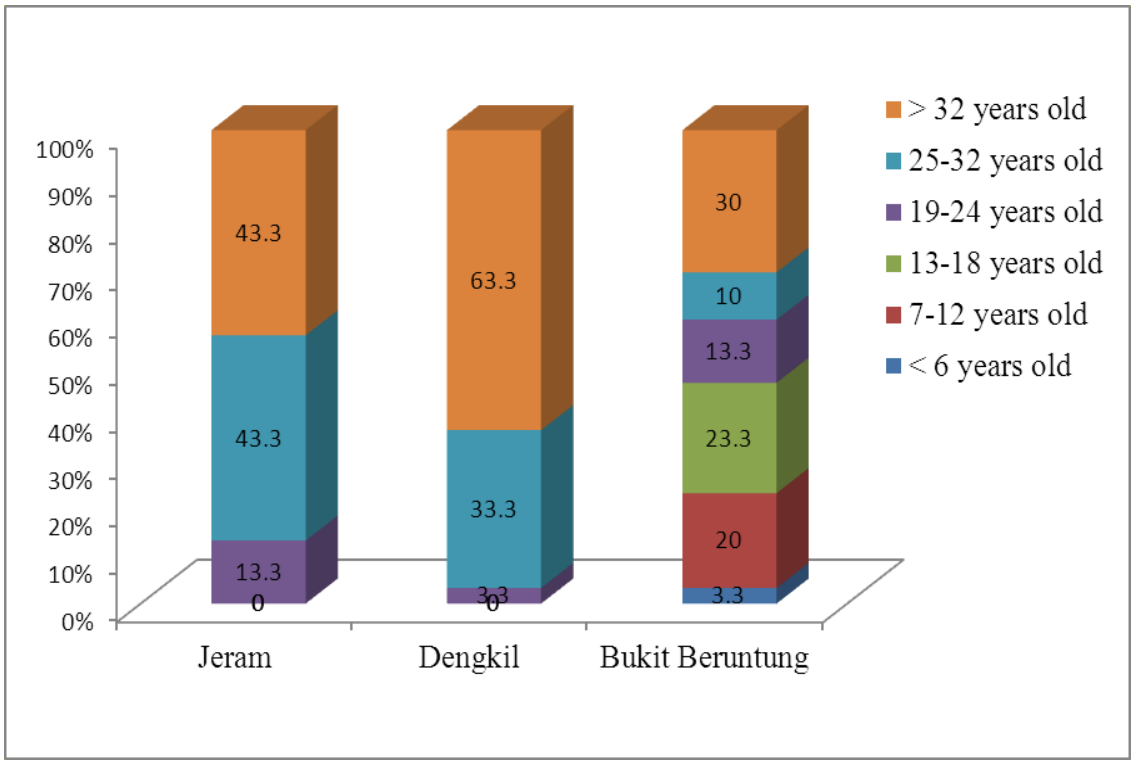

Figure 4.2: The percentage of waste pickers' age for each landfill

Since, working in landfills do not require specific skills, it is most suitable for them. There were also those aged 25 years and above, (although they had the experience and skills to work in other sectors of employment) who choose to work in landfills because their previous employers did not renew their employment contract.

Waste pickers in Bukit Beruntung dumpsite were mostly of school age (under 18 years old). These children spend their free time (after school or during school holidays) to find items that can be recycled in the landfill. They enjoy scavenging for recyclables without any pressure from any party. When the respective parents of the children were asked if the involvement of their children at the dumpsite affect their education, parents felt that it does not. The parents were more comfortable with their children helping to

collect recyclables and earning their own pocket money than with the children wasting time in shopping malls or getting involved with social ills. While surveys were conducted, there were also students who skip school come to work in the landfill since examination at school was over.

There were also women who bring their children in body carrier (less than a year) to the landfill. The reason is because there was nobody take care of the baby at home when the mother goes out to work. On the other hand, they have to bear additional cost if they were to hire a nanny. Therefore the best strategy for them is to keep the babies with them while working. Plate 4.2 shows respondents from various types of age working in the landfill that was studied.

Plate 4.2: Children aged nine years (still in school) with his father looking for materials that can be recycled at the Bukit Beruntung landfill and waste pickers between 19-24 years in Jeram landfill.

Table 4.2 shows the average age of waste pickers. Mean age of waste pickers in Jeram was 30 years old, while the youngest was 20 years old. The eldest waste picker was 45 years old.

Table 4.2 Average age of waste pickers in each landfill

	Jeram sanitary landfill	**Dengkil non sanitary landfill**	**Bukit Beruntung open dumping**
Mean	30.53	35.40	23.43
Minimum	20	23	3
Maximum	45	57	47

In Dengkil, the mean age of waste pickers was 35 years old, while the youngest was 23 years old, and the eldest was 57 years old. In Bukit Beruntung, the mean age was 23 years old, where the youngest was three years old, and the eldest was 47 years old. In contrast with study by Seow and Indera (2006), the youngest waste picker was 12 years old and the oldest was 80. Most of waste pickers are below 20 age years old who involve in this activity for additional pocket money. This is similar to the findings of Seow and Indera (2006).

4.1.3 Type of races found in three landfills

Various races were involved in waste picking activities in the landfills. Among the races involved are Malay, Madura, Surabaya, Bangladeshi, Minang, Javanese and indigenous people. According to the management, the involvement of different races has its own advantages. Figure 4.3 shows the races involved in the waste picking activities in the three landfills.

There were 56.7% Madura in Jeram, 60% in Dengkil, and only 10% in Bukit Beruntung. The Madura people are well-known for their physical strength. They were willing to do heavy work regardless of gender. The Javanese only make up 6.7% of the waste pickers found in Jeram and they make up 36.7% of the waste pickers in Dengkil. Meanwhile people from Surabaya only make up 36.7% of the waste pickers found in Jeram. Both of these people are mostly involved in other employment sectors in

Malaysia. Other than that, the Bangladeshis and Malays make up 3.3% of the waste pickers found in Bukit Beruntung. Bangladeshis and Malays are also less likely to be involved in this sector due to their involvement in other sectors. The highest percentages of the waste pickers in Bukit Beruntung were indigenous people contributing 83.3% of the total waste pickers. They come to the landfill because it is near to their residence and also to increase their family income.

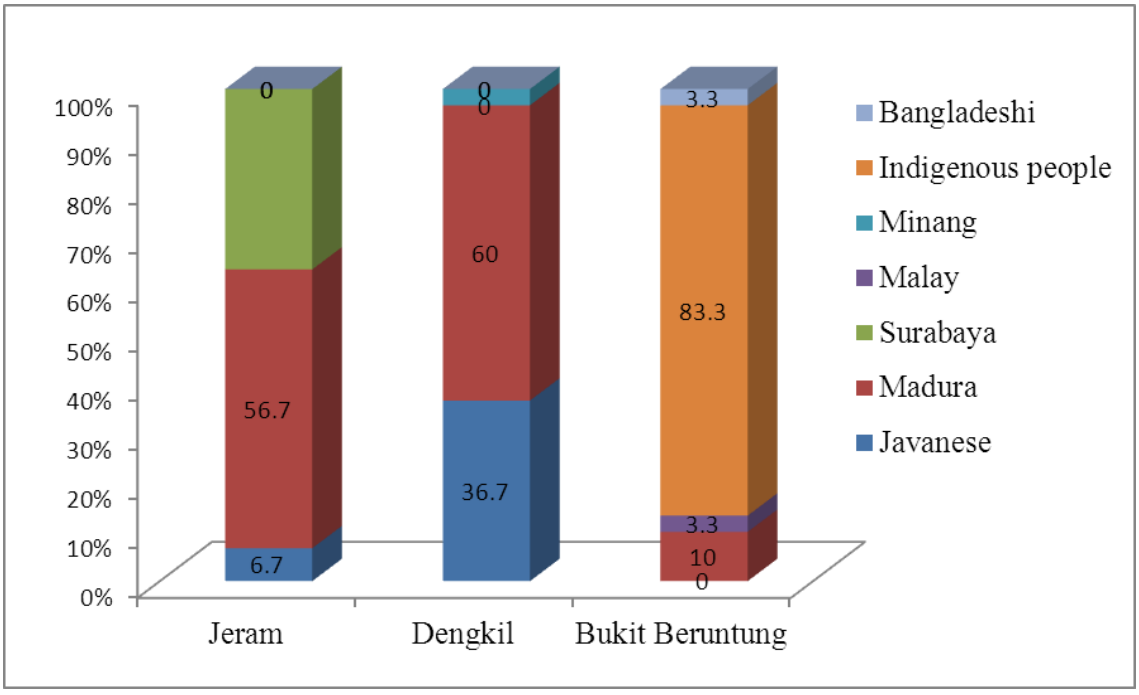

Figure 4.3: Percentage of waste pickers according to races

The management in Jeram and Dengkil prefer to hire Madura people from Indonesia for their well-known hardiness. The management is more concerned with the reduction of waste in the landfill compared to the income earned by the waste pickers. Previously, the management have hired workers from other countries such as Nepal, Myanmar, and Bangladesh but the workers were not as cooperative as the Indonesians. Unlike that of Bukit Beruntung dump where waste reduction in the landfill is not a concern, there is no restriction on nationality to work in the landfill. In this case, the majority of the waste pickers who come to Bukit Beruntung landfill were locals who live near the landfill. It

is because Bukit Beruntung landfill is near to the indigenous people's settlements that they make up the largest group. This result is in contrast to the study performed by Kusumawati (2009), where participation by race in waste picking activities in Bandung were a majority (88%) from Sunda, followed by 4% Javanese.

4.1.4 Waste pickers' religion

Figure 4.4 shows that waste picker who works in Jeram and Dengkil disposal site were 100% Muslim. While in Bukit Beruntung dump, the waste pickers were 63.3% Muslim, 23.3% Christian and 13.3% with no religion.

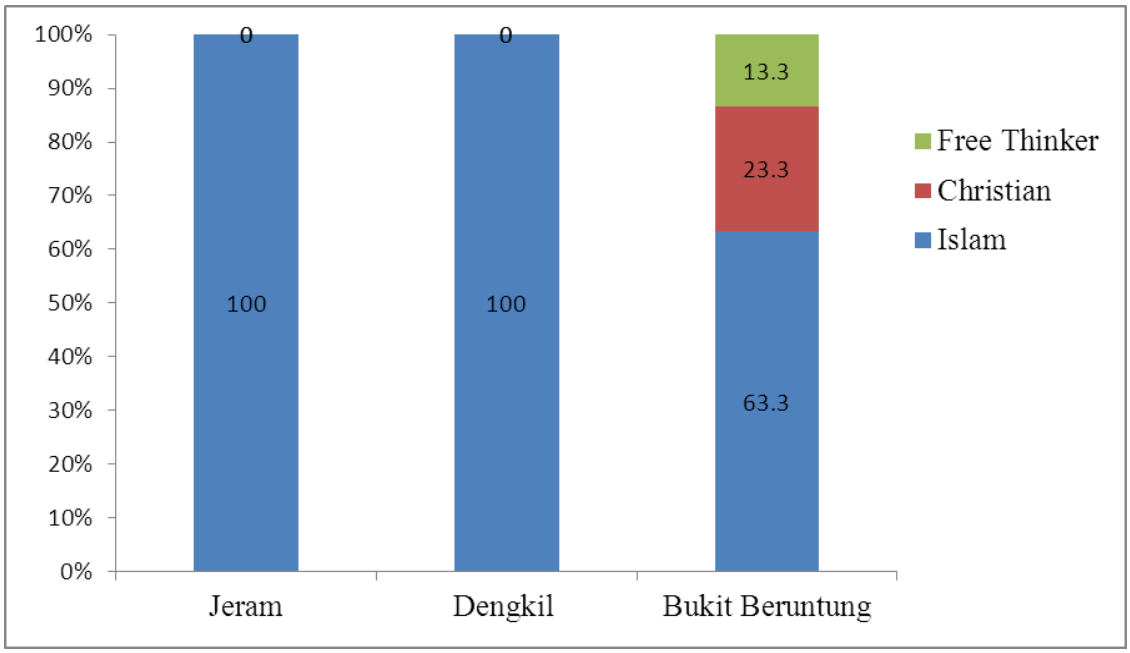

Figure 4.4: Percentage of waste pickers' religious in three landfills

For Muslim waste pickers, even though working as a waste picker may seem disgusting and dirty to the society, the waste pickers feel that their work is alright as long as it is lawful in Islam. In contrast to studies done by Furedy (1984a), in Muslim countries, non-Muslim usually performs refuse collection and recycling since contact with waste materials is considered impure by the Muslims. Similarly, from studies conducted in

Cairo, it is discovered that many waste pickers belong to the Christian minority (Berthier, 2003). The result of this research obviously in contradictory to other studies.

4.1.5 Nationality of waste pickers in the three landfills

Figure 4.5 shows the percentages of waste pickers based on citizenship in the three landfills. The percentage of Malaysian citizens in Bukit Beruntung dump was 83.3%. Meanwhile waste pickers in Dengkil and Jeram landfills were 100% Indonesian. In Bukit Beruntung, Indonesians make up about 16.7% of the waste pickers. The management in Jeram and Dengkil (as per discussed in Figure 4.3) were more comfortable working with Indonesians. According to them, the Indonesians have a higher endurance required for heavy work and are willing to endure hot weather. They are hardworking and are rarely sick. Unlike waste pickers in Johor, where only 25% of them are foreigners, most being from Indonesian and Nepali (Seow, 2012).

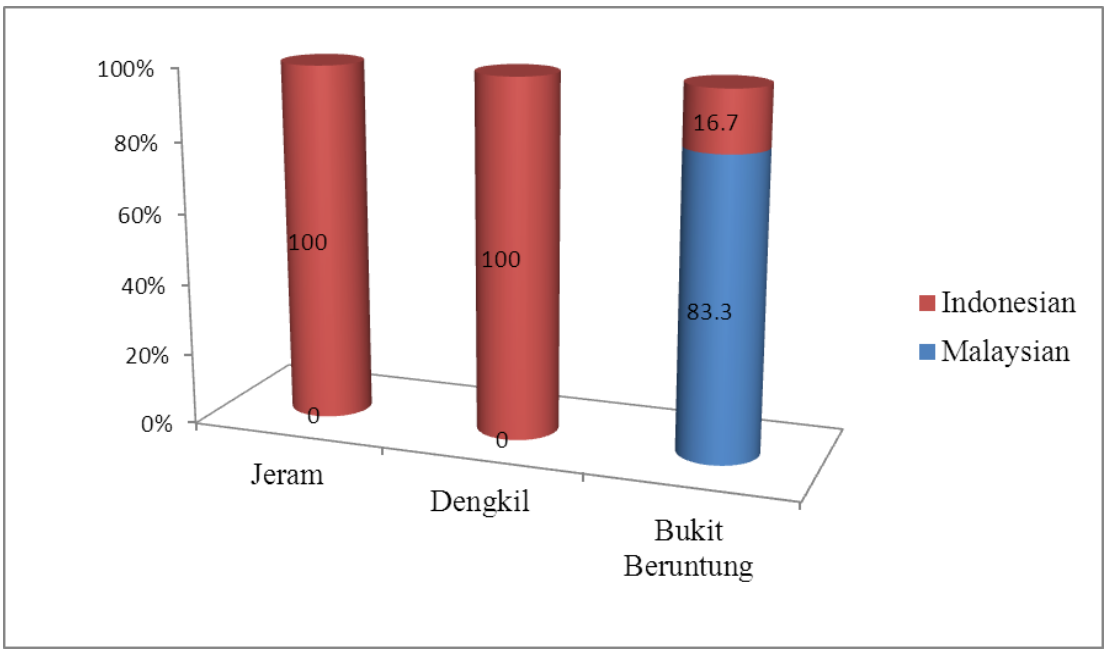

Figure 4.5: Waste pickers' nationality in the three landfills.

4.2 Part B: Socio-Economic Status

4.2.1 Education level of waste pickers in landfills

Waste pickers' level of education was also analyzed. Figure 4.6 shows that waste pickers in Jeram (86.7%), Dengkil (66.7%) and Bukit Beruntung (36.7%) were with primary school education. Meanwhile 10% of waste pickers in Jeram, 13.3% in Dengkil and 56.7% in Bukit Beruntung were with high school education. 3.3% waste pickers in Jeram, Dengkil 20% and 6.7% in Bukit Beruntung received no education. Jeram and Dengkil landfills waste pickers were Indonesian where education was not compulsory. Most who were without education are that way mainly due to poverty. In Bukit Beruntung, a majority of the waste pickers have secondary education. Most of them were Malaysians who did not further their study to a higher level because of a lack of qualification or because the cost of higher education was unaffordable for them. Waste pickers with primary education were still in school and the waste picking activity was a part-time work for them. In comparison with a study by Seow (2012), 18% of the waste pickers in Johor never got formal educations or have only limited education.

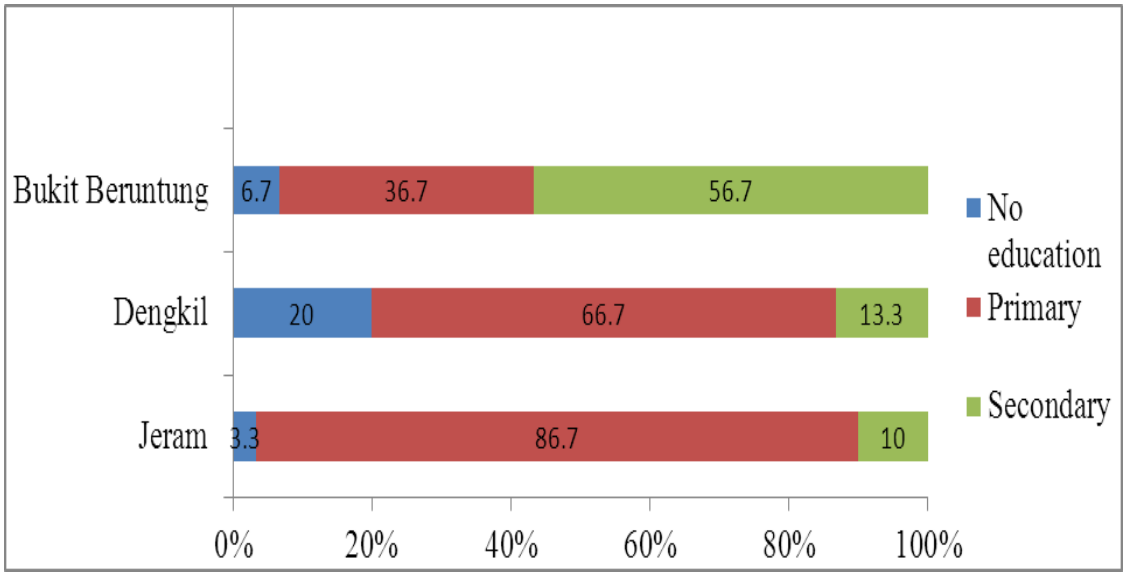

Figure 4.6: Percentage of waste pickers' education level in landfills

4.2.2 Marital status of waste pickers in each landfill

The marital status of waste pickers in the three landfills were categorized into single, married and widowed. 96.7% of waste pickers in Jeram landfill were married while the figure is 73.3% in Dengkil and 33.3% in Bukit Beruntung. Most of them have a spouse (husband or wife) who also work in the same landfill. In Jeram and Dengkil landfills, most of the waste pickers have gotten married before migrating to Malaysia. They came to Malaysia because they want to earn more money to support their family (children or spouse) in Indonesia. Single waste pickers in Jeram were 3.3% followed by 16.7% in Dengkil and 63.3% in Bukit Beruntung. Interestingly, in Bukit Beruntung dump many waste pickers were of schooling age. Thus, the percentage of single waste pickers was highest in Bukit Beruntung dump.

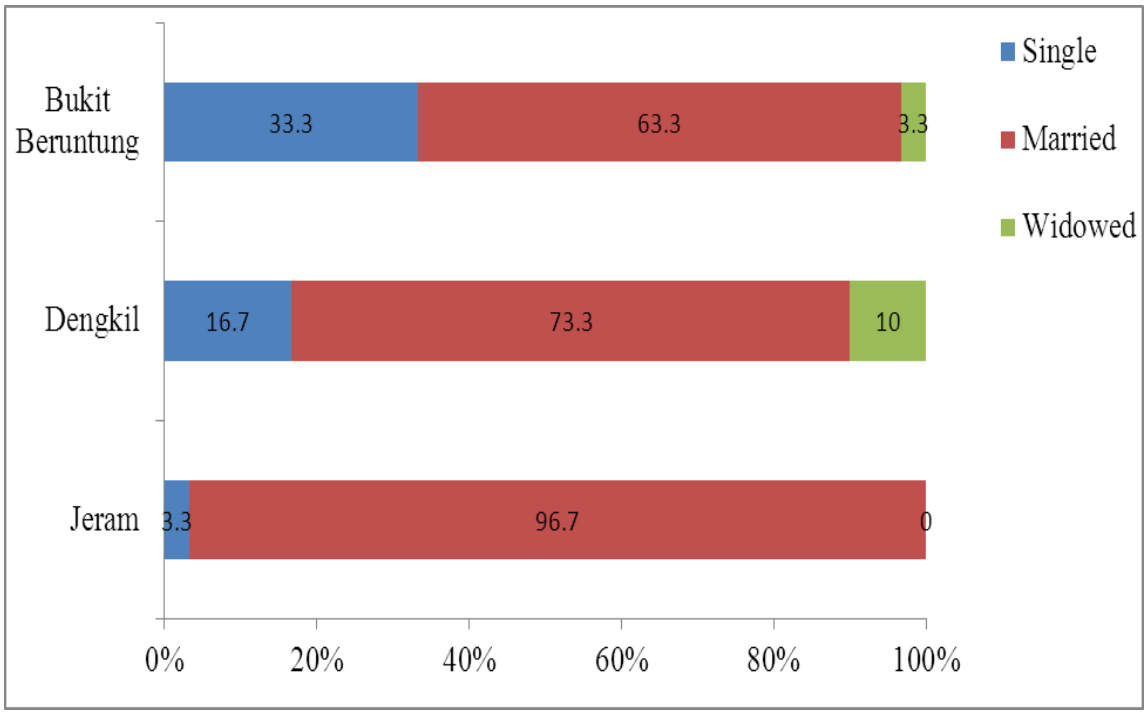

Figure 4.7: Percentage of marital status of waste pickers in each landfill

4.2.3 Number of waste pickers' liabilities

Liability means people supported by waste pickers which include children, parents and siblings. Based on Figure 4.8, waste pickers without any liability were 10% in Dengkil and 26.7% in Bukit Beruntung. Jeram recorded the 0% because most of the respondents in Jeram were married and have children in their home country. They also send home money to their parents because most of them were from low-income families.

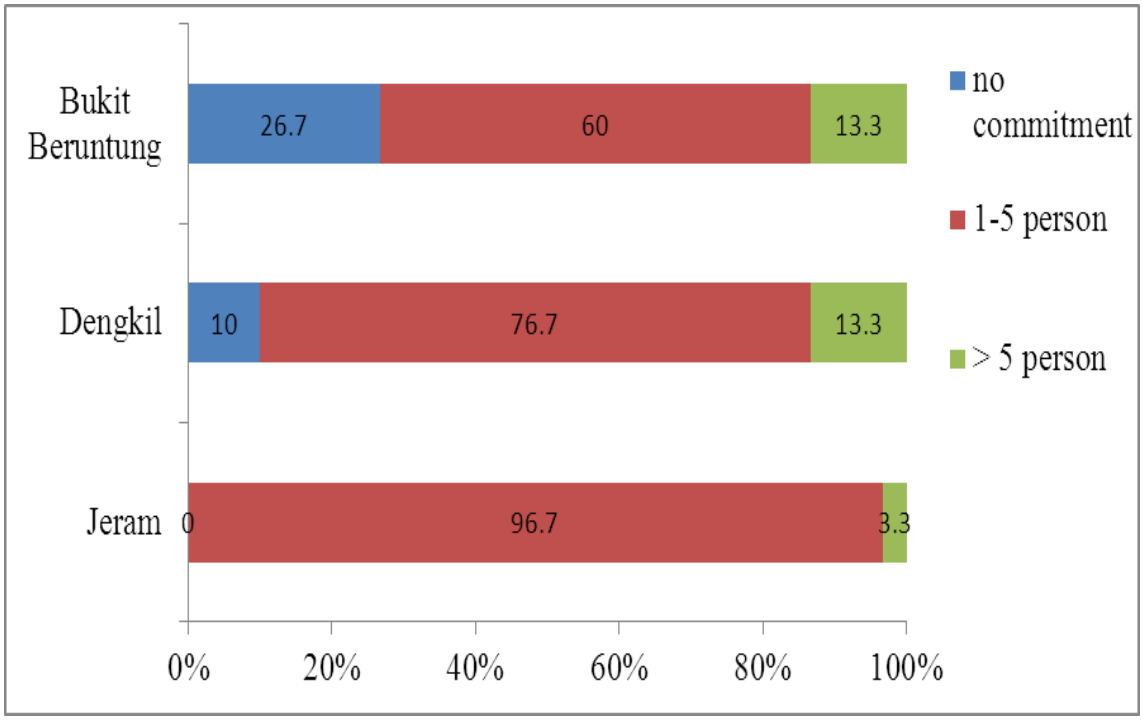

Figure 4.8: Percentage of waste pickers' liabilities in each landfill

Waste pickers in Bukit Beruntung who do not have any liabilities were those who were unmarried and have no job opportunities in other sectors. Waste pickers with less than five liabilities were 96.7% in Jeram, 76.7% Dengkil and 60% in Bukit Beruntung. Most of them do not have many children, especially waste pickers from Jeram and Dengkil. They also prefer not to have many children since it would require more money to provide maximum comfort and convenience to their children. Most of them take birth

control pills and only send money to their family monthly.

Waste pickers who have more than five liabilities in Jeram were 3.3%, while Dengkil and Bukit Beruntung both were 13.3%. As for this group, they prefer to have many children to help them in the future. They also do not mind spending money on food. This is because most of them grow their own food and breed animals for food, especially for when they are short on money.

4.2.4 Involvement as waste pickers

Most of the waste pickers (90% in Jeram, 100% in Dengkil, and 40% in Bukit Beruntung) were full timers. This is because majority of them were non-locals with work permits that prohibit them from holding two jobs simultaneously. The majority of Bukit Beruntung (60 %) waste pickers were part-timers. This is because most of them were Malaysians who have permanent jobs such as gardeners, farmers, self-employed and students. They come to the landfill occasionally to get extra income. The result is similar to Seow (2012) discovery where most of the part time waste pickers have other full time job such as security guards, operators and cleaners. They collect waste after their working hours, to increase their income and support their family. The percentages of those who are with primary jobs are 74% (Seow et al., 2006).

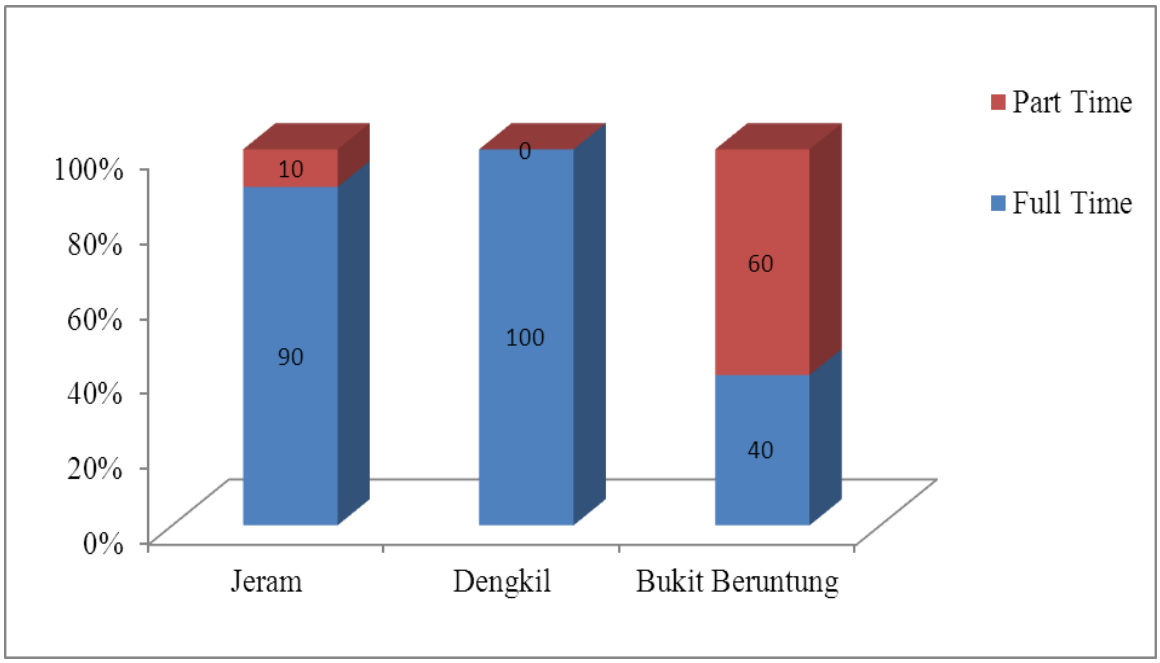

Figure 4.9: Involvement of individual as waste pickers

4.2.5 Factors influencing involvement as waste pickers

The main factors why waste pickers are involved in this activity are the relatively high income and not having other job opportunities. 100% of respondents from Jeram admitted that they scavenge in landfill because it is a well-paying job. Yet, in Dengkil and in Bukit Beruntung only 13.3% and 50% respectively feel that waste picking is a well-paying job. 86.7% in Dengkil and 50% in Bukit Beruntung choose to work in the landfill because there were no other jobs available. According to the management, most of waste pickers in landfill do not have specific skills to take on other jobs. So, collecting waste was the best choice for them since it gave a well-paid income based on the amount of recyclables they managed to collect. This is different from the result by Kusumawati (2009) that reported 19% of the waste pickers in Indonesia got involved in waste picking as a part-time job to increase their income instead of not having other job opportunities.

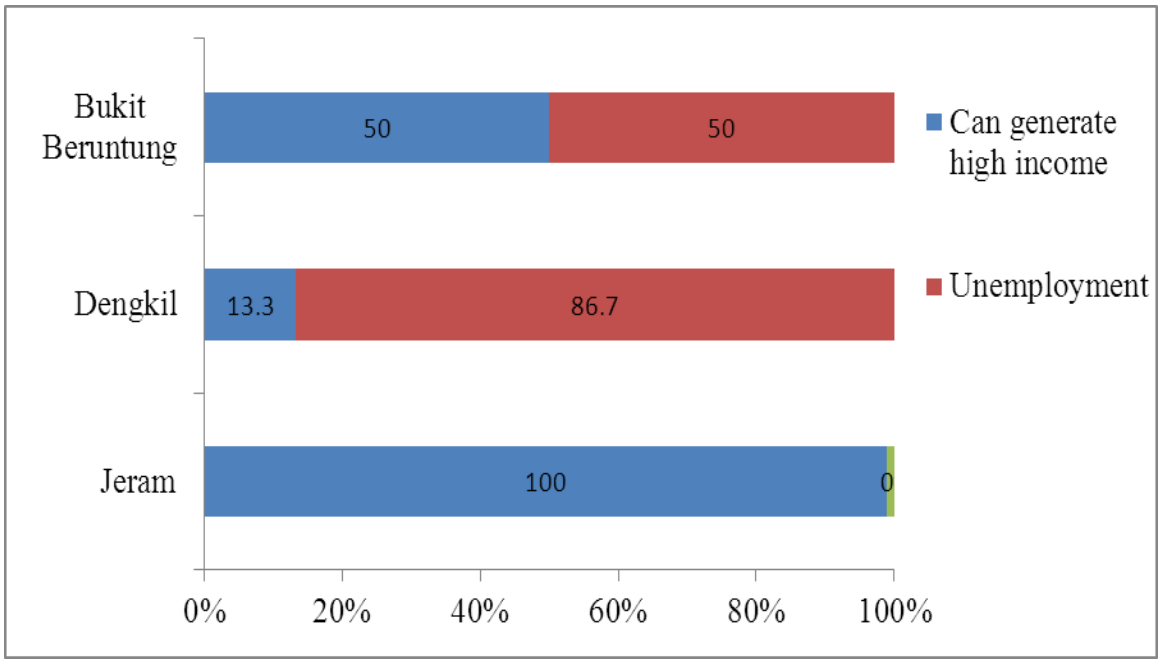

Figure 4.10: Reason working as waste picker

4.2.6 Income earned by the waste pickers for each landfills

Figure 4.11 shows the approximate monthly income earned by the waste pickers. Based on the analysis performed, 6.7% waste pickers in Dengkil and 30% in Bukit Beruntung have a monthly income of RM250-RM500. While waste pickers with monthly income from RM501-RM750 in Jeram were 13.3%, 43.3% in Dengkil and 26.7% in Bukit Beruntung. Those with an income between RM751-RM1000 are 60% in Jeram landfill, 50% in Dengkil and 23.3% in Bukit Beruntung. This income was recorded as the maximum income a waste picker could earn in Dengkil. The highest income was more than RM1000. This income was achieved by 26.7% of the waste pickers in Jeram, and 20% in Bukit Beruntung.

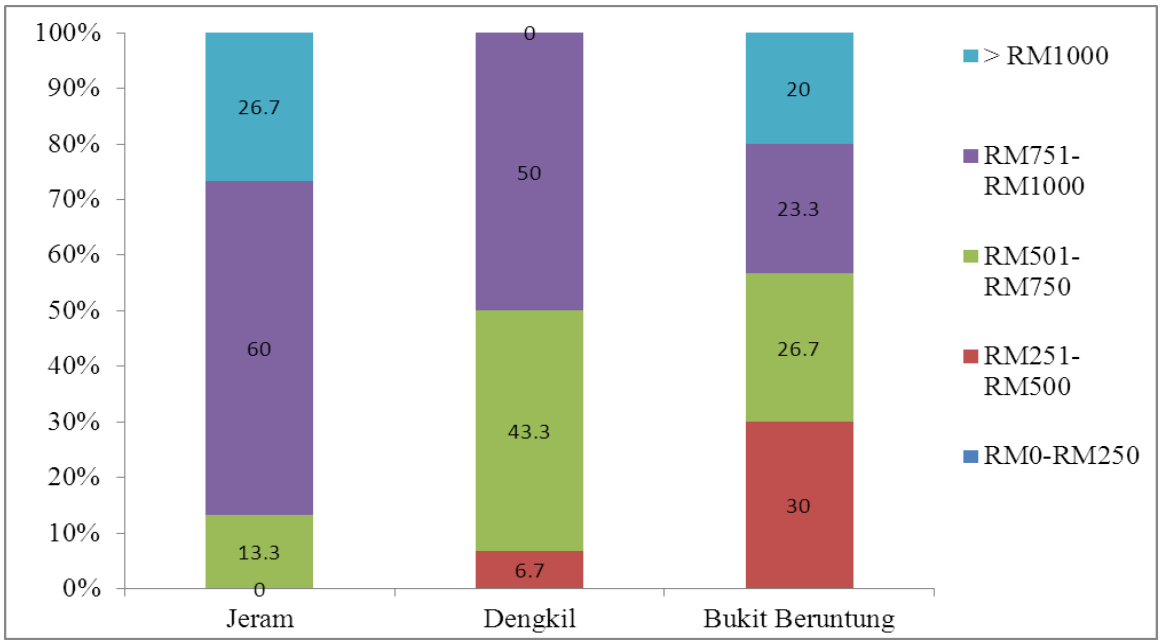

Figure 4.11: Income earned by the waste pickers in the selected landfills

Table 4.3 shows the detail of income earned by waste pickers. In Jeram landfill the minimum income of respondents was RM700 and the maximum was RM1200 while the mean was RM 956.67.

Table 4.3: Per month income earned by waste pickers in selected landfills

	Jeram sanitary landfill	**Dengkil non sanitary landfill**	**Bukit Beruntung open dump**
Mean	RM956.67	RM 773.33	RM 736.67
Minimum	RM700	RM500	RM 300
Maximum	RM1200	RM 1000	RM 1200

Since, Jeram landfill received various types of recyclables materials in the waste stream (Plate 4.3). Collecting more recyclable materials is much easier. On the other hand, the minimum and maximum waste pickers' income in Dengkil were RM 500 and RM 1000, respectively. The mean of waste pickers' income in Dengkil was RM 773.33. This is because the landfill in Dengkil received more than 57% of garden waste which can only be composted. Thus, recyclables retrieved was limited.

The minimum and maximum income of waste pickers in Bukit Beruntung landfill were RM 300 and RM 1200 respectively, with a mean of RM 736.67. In general, waste pickers' income depended on how much waste or recyclable material is available for collection, the type of landfills they were in and how many hours they work in a day. Some of the waste pickers work overtime and work during their break. This is because they have to compete with each other in a landfill especially in Dengkil and Bukit Beruntung. Therefore, if they work overtime they can collect more waste and increase their income. From the interviews carried out, it is discovered that some waste pickers are not satisfied with the price offered by the middlemen. This is because they are not following the current standard global price. This result contradicts the findings by Seow *et al.*, (2006) who reported the income of waste pickers is dependent on the global market price. Medina (1997a) too reported that waste pickers' low income can be attributed to the low prices paid by middlemen for their recyclables. However both Seow *et al.,* (2006) and Medina (1997a) did not state whether or not working time and dump sites have any effects on the waste pickers' income level.

Plate 4.3: Garden waste sent to Dengkil landfill and various types of recyclable materials collected at the Jeram landfill.

The correlation between income and time spend in landfills is not significant. This is probably due to the fact that some landfills do not contain much recyclable material, Dengkil is one such landfill. Despite the amount of hours put into scavenging, most of the waste in the Dengkil landfill was garden waste which is not valuable for the waste pickers. Income however, is significantly correlated to the total amount of recyclable material collected among the waste pickers with a correlation coefficient of 0.060.

4.2.7 Types of wastes collected by waste pickers

Figure 4.12 shows the type of waste collected by waste picker in each landfills. In Jeram, all of the waste pickers stated that they collect plastic materials as indicated in Plate 4.4. Only 96.7% of them collect steel and 10% collect wood-based materials. Most waste pickers in Jeram focus on collecting recyclable materials as these are the items with the most market value. This is possible since Jeram landfill receives 95% domestic waste that consist some recyclable materials.

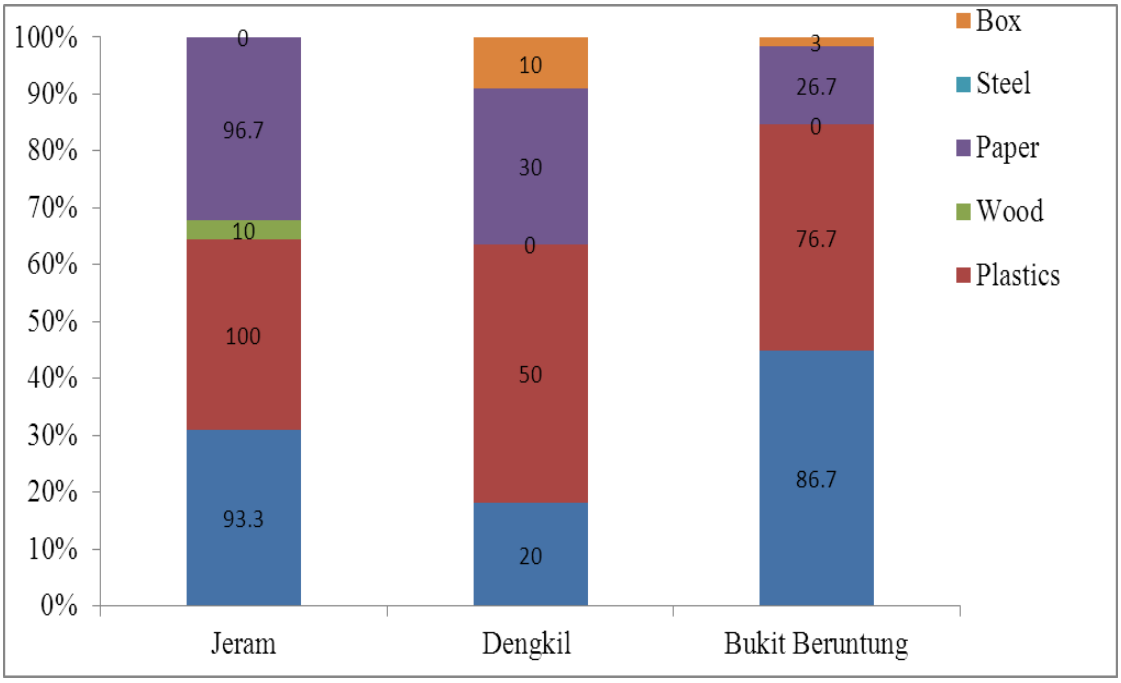

Figure 4.12: Percentage types of waste collected by the waste pickers in each landfill

Plate 4.4: Plastic materials collected by waste pickers in Jeram.

In Dengkil, 50% of the waste pickers collect plastic based materials. Only 30% collect paper based materials while 20% collect metal, and 10% collect boxes. The percentage of those who collect recyclable materials in Dengkil was lower than that in Jeram due to the nature of the waste at the landfill, which consists of up to 57.9% garden waste. Whereas in Bukit Beruntung, 86.7% of waste pickers collect metal materials for recycling, 76.7% collect plastic materials, and 3% collect boxes. This is probably due to the waste received by Bukit Beruntung landfill which is a general mixture from household, commercial, and industrial sectors.

Steel, aluminum, plastic, paper, glass and boxes were the recyclable materials routinely removed from municipal solid waste streams as indicated in Plate 4.5. Waste pickers from all landfills do not collect and recycle textile waste, which is contradictory to the study by Kaseva and Gupta (1996). Waste pickers here do not retrieve organic waste. This is contradictory to the study by Dulac (2001).

Plate 4.5: CDs and aluminium based waste materials were collected by waste pickers.

4.2.8 Weight of materials collected by the waste pickers in a day

Figure 4.13 shows the total weight of waste collected by the waste pickers for each landfills.

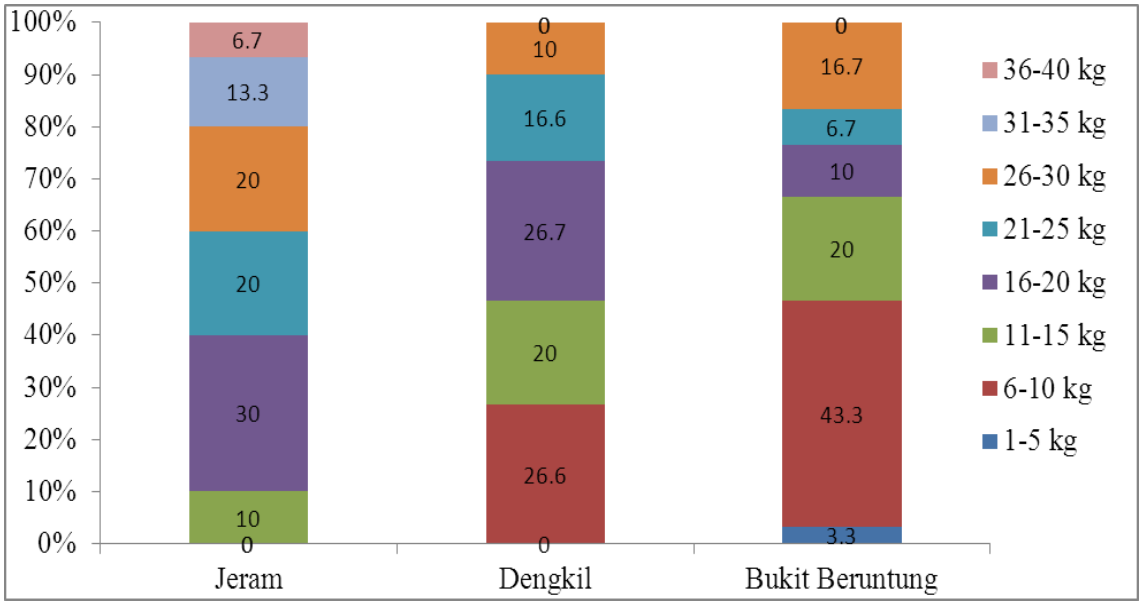

Figure 4.13: Weight of recyclable material collected in a day at each landfills by waste pickers

The minimum weight of collected materials was between 1-5 kilogram in a day and the maximum weight could reach 36-40 kilogram per day. Only 3.3 % of waste pickers in Bukit Beruntung can collect 1-5 kilogram recyclables per day. 26.6% of the waste

pickers in Dengkil and 43.3% of waste pickers in Bukit Beruntung have a daily collection of 6-10 kg/day. This is because most of waste pickers were part- time workers. Usually, the waste pickers will combine their entire daily collection into gunny sacks prior to weighing as indicated in Plate 4.6. They spend only a few hours in a day to find recyclable materials. Most of them come to the landfill to gain some side income. 20% of waste pickers in Jeram, 20% in Dengkil and 20% in Bukit Beruntung, have roughly the same daily collection of 11-15 kg/day. This amount is the minimum of weight collection per-day by the waste pickers in Jeram landfill.

Plate 4.6: Recyclable materials collected and filled into gunny sacks ready for weighing.

Meanwhile, 30% of the waste pickers in Jeram have a routine collection of 16-20 kg/day. There were waste pickers in other areas with the same routine daily collection, and the numbers were 26.7% in Dengkil and 10% in Bukit Beruntung. Also in Jeram, 20% of the waste pickers have a daily collection of 21-25 kg/day and the percentages of those with the same daily collection in other areas were 16.6% in Dengkil and 6.7% in Bukit Beruntung. As for the percentages of waste pickers with the maximum recorded daily collection of 26-30 kg/day, the numbers are 20% in Jeram, 10% in Dengkil, and 16.7% in Bukit Beruntung.

The result of this study is similar to the one carried out by Seow (2005). It was found that quantification of the total contribution by the waste pickers in reducing wastes in landfills is difficult. The informal nature of this sector inherently implies a lack of official statistical data. This finding differs from the study carried out by Bartone et al (1991), where it was estimated that 10% of the municipal waste in Mexican landfills was removed by waste pickers. While Baud and Schenk, (1994) estimated that 15% of waste in Banglore was reduced by waste pickers. On the other hand Ali *et al.*, (1993) estimated that 10% of waste pickers in India removed the present municipal waste from its disposal.

4.2.9 Income of waste pickers and their financial capability to support their family

Figure 4.14 shows waste pickers' opinion on whether or not their income is adequate to support their family.

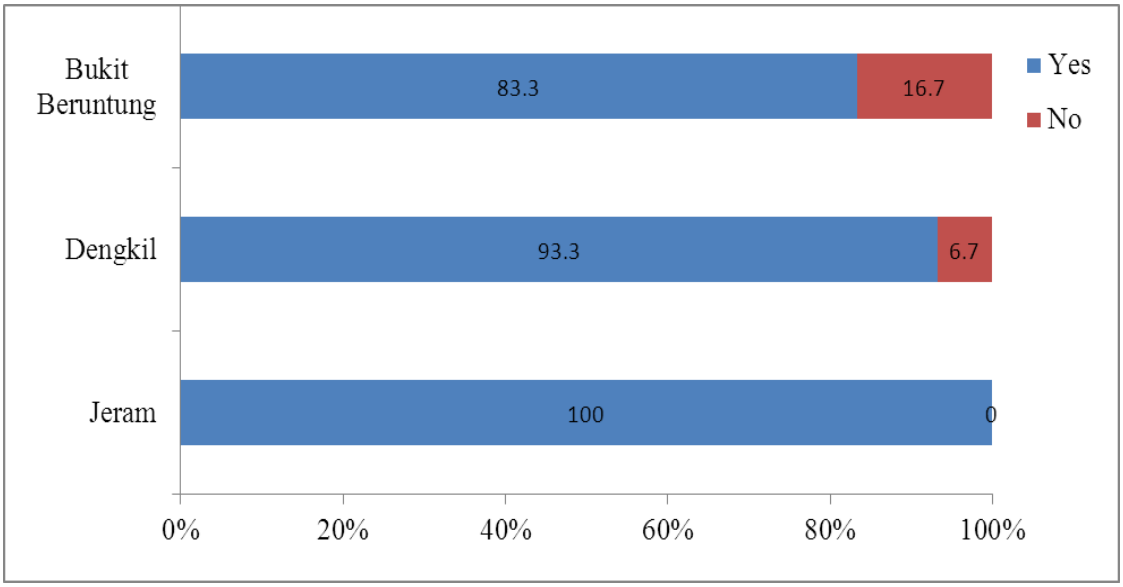

Figure 4.14: Opinion on whether earnings from waste scavenging can support waste pickers' family

All (100%) of the waste pickers in Jeram agreed that their income can support their

family. While 93.3% in Dengkil and 83.3% in Bukit Beruntung also agreed that they are able to support their families with their income. This is because they do not have many children. In spite of the adequacy of their respective incomes, many waste pickers are still unhappy since the price of recyclable materials is dependent on the global price. This is also reflected in the result from (Seow *et al.*, 2006) that stated the global price of recyclable materials fluctuates, and that in turn causes the income level of the waste pickers to fluctuate also. In addition, they come from poorer countries with weaker currency that their income in Malaysia becomes significantly more valuable when compared to that obtained in their country. From survey 6.7% of the waste pickers in Dengkil and 16.7% in Bukit Beruntung claimed that their income was inadequate to support their family. This is because they have many children who are still schooling.

4.2.10 Waste pickers' opinions about the payments made by the middlemen

The management of the landfills have prepared weighing scales to be used by the waste pickers in order to facilitate the process of weighing and selling their collected recyclable materials to their respective middlemen (Plate 4.7). These middlemen appointed at the three landfills are all from different companies. 43.3% waste pickers from Jeram, 30% from Dengkil and 13.3% from Bukit Beruntung indicated that the price offered for recyclables was low. It was found that the prices offered by middlemen and off-site recycling center disposal were different with middlemen rate being much lower. Waste pickers feel that the price gap should not exist. Only 50% in Jeram, 63.3% in Dengkil and 80% in Bukit Beruntung considered the price offered being reasonable only.

Plate 4.7: Recyclable materials ready for weighing.

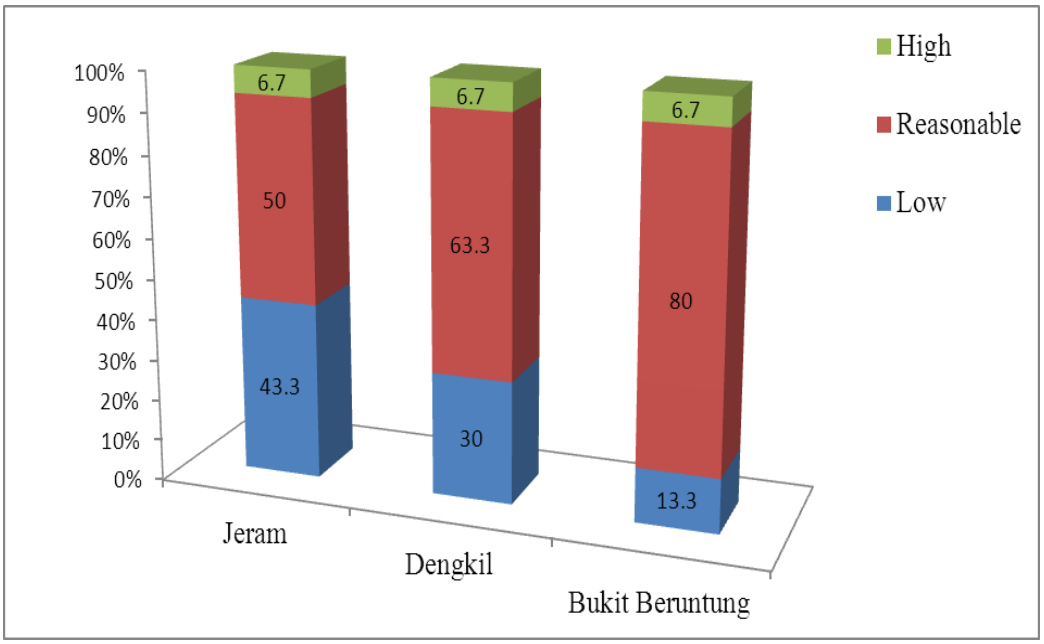

Figure 4.15: Waste pickers' opinion on the payment by the middlemen

This is most likely because they do not have transportation to deliver the recycled goods to the recycling center (Plate 4.8). In addition, the presence of middlemen in landfills can facilitate and expedite their sale. However, 6.7% of respondents in Jeram, Dengkil and Bukit Beruntung indicated that the price offered was quite high. Generally, majority of waste pickers in the three landfills thought that the prices offered were reasonable.

Plate 4.8: Recycled goods compacted and ready to be transported to recycling centres.

4.2.11 The distance from waste pickers' home to landfill.

Distance from waste pickers' home to the landfill was also studied. 3.3% of waste pickers in Jeram and Bukit Beruntung and 76.7% in Dengkil indicated that they reside less than 500 meters from landfills. Waste pickers that indicated the distance between 510 meters to one kilometer was 96.7% in Jeram, 23.3% in Dengkil and 46.7% in Bukit Beruntung. In terms of distance from their homes to the landfills, 26.7% of the waste pickers live around 1.1 kilometer to 2 kilometer from the landfills, 6.7% live over 5 kilometer away from the landfills, and 3.3% live less than 500 meter away from the landfills. Therefore, the majority of respondents' reside less than a kilometer from Jeram and Dengkil landfill since their employers provide shelters nearby to help them save time and transportation costs.

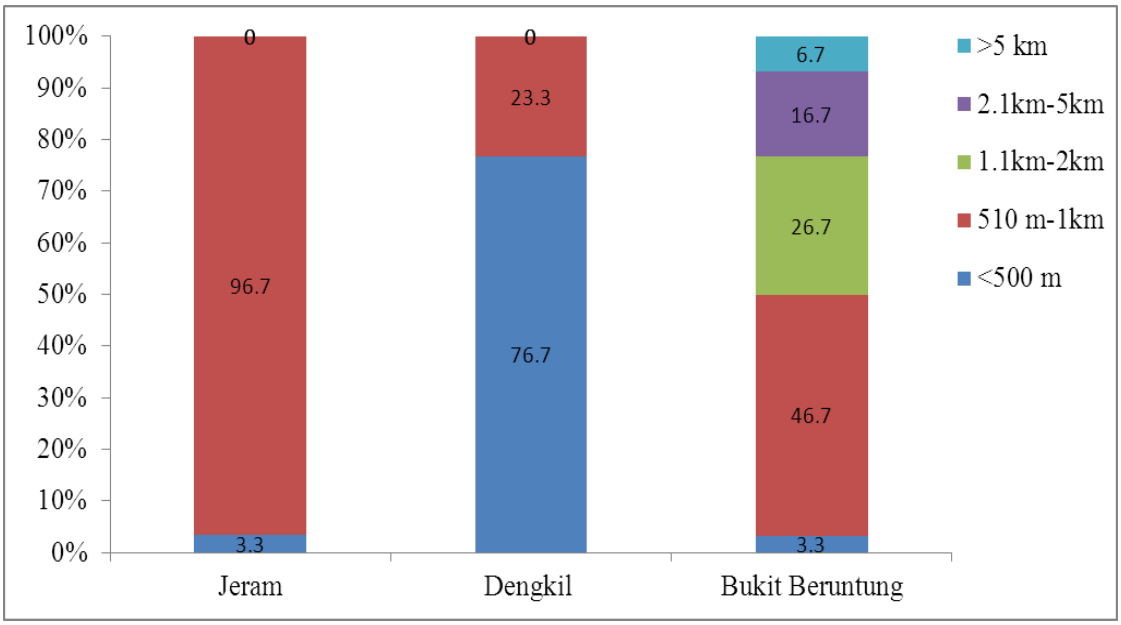

Figure 4.16: Percentage of distance from waste pickers' home to landfill

4.2.12 Method of transportation to the landfill

In this study, transportation method to the landfill was also investigated. While all of the waste pickers in Dengkil walked to the landfill, in Jeram and Bukit Beruntung the numbers were 80% and 40%, respectively. Most waste pickers in Jeram and Dengkil walk to the landfill because their residence is close to the landfill. Besides not having a mode of transportation they also consider walking a cost effective way of moving around. 16.7% in Jeram's and 50% in Bukit Beruntung ride their bicycles and motorbikes to work (Plate 4.9). This is because they stay quite far from the landfill. In Bukit Beruntung, the waste pickers ride their motorcycles to the landfill. Interestingly, most of the waste pickers who own motorcycles were part-timers. Approximately 3% of respondents from Jeram and Bukit Beruntung landfill used bicycles to go to landfill.

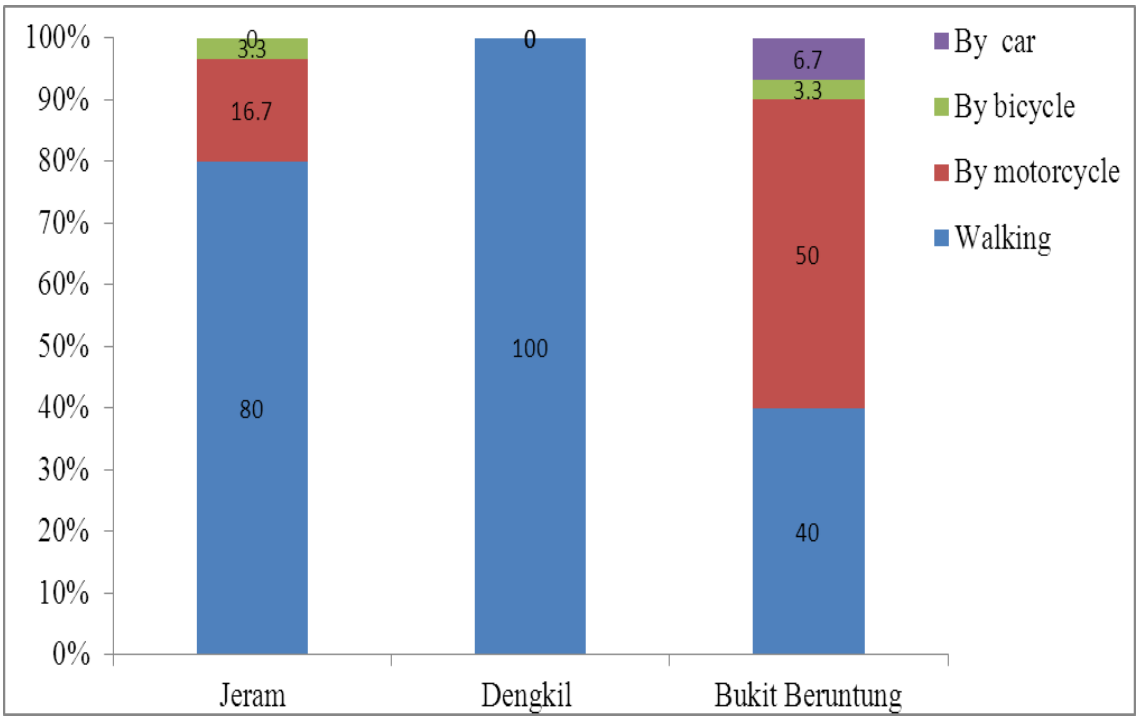

Figure 4.17: Method of transportation to the landfills

Plate 4.9: Waste pickers' motorcyle parked at landfill

4.2.13 Waste pickers' willingness to provide education for their children

Waste pickers' willingness to provide education for their children was also studied. All of the waste pickers (100%) in Jeram and Dengkil were willing to provide education to their children. They realize that education is vital. They even send money to their home-towns specifically for their children's education, apart from the usual living expenses. However, in Bukit Beruntung only 70% of the waste pickers were willing to provide educational opportunities for their children. 6.7% were not willing to provide education to their children and 23.3% were unsure.

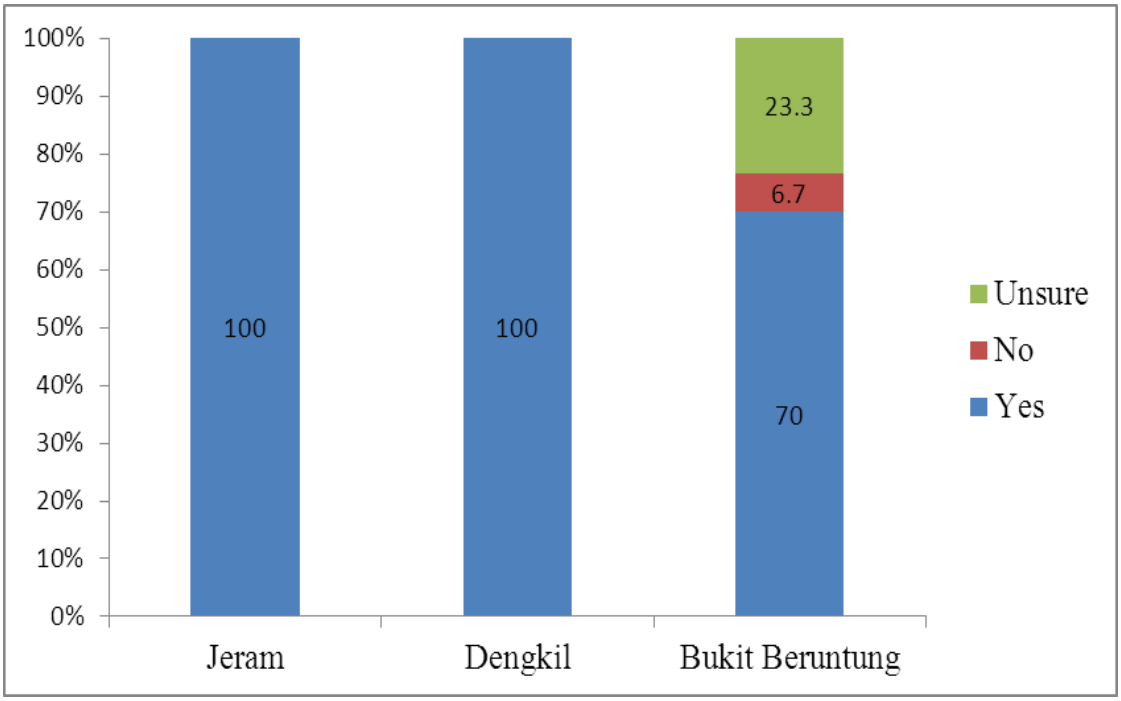

Figure 4.18: Waste pickers' willingness to provide education for their children

4.3 Part C: Occupational Safety and Health

4.3.1 Waste pickers' involvement in scavenging activity

Figure 4.19 shows the waste pickers' duration of involvement in scavenging activities. The percentage of respondents who have been engaged for 0-6 months in Jeram was 13.3%, and the figure is 20% in Dengkil and 23.3% in Bukit Beruntung. The percentage of waste pickers who have been engaged for 7-12 months in Jeram was 26.7%, 20% in Dengkil and 16.7% in Bukit Beruntung. In Jeram, the percentage of waste pickers who have been involved in this job more than a year between 13 to 24 months was 33.3% and the figure is 30% both in Dengkil and Bukit Beruntung. Meanwhile, the percentage of respondents who have been involved for more than two years in this field (24 months and above) in Jeram was 26.7% and 30% both in Dengkil and Bukit Beruntung.

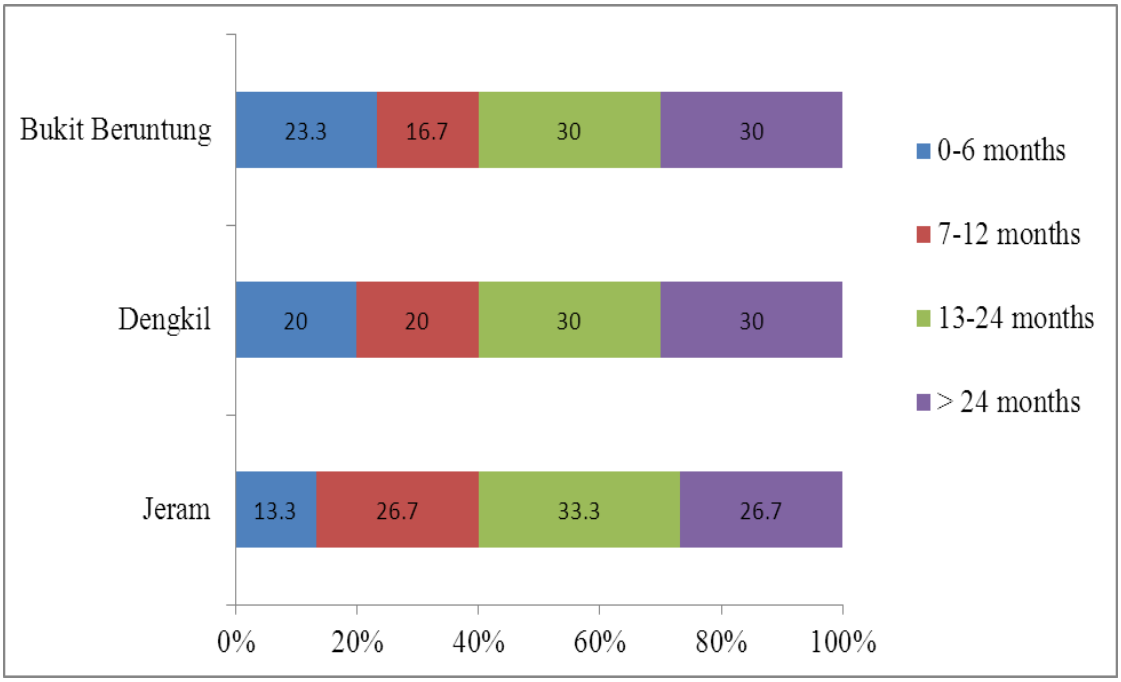

Figure 4.19: Percentage of waste pickers' involvement with scavenging activity (in months)

The majority of waste pickers in all landfills were those who have been involved in this work for a long time, mostly more than a year. Waste pickers' involvement was

important to determine how they work. Experience plays a big role in working as a waste picker. Among the waste pickers, the ones who have been working for a long time have the most understanding on their work and environment. Not only do they know which garbage truck trip is the one with the most content, they also know what type of materials come with each trip. This hard earned knowledge allows them to save and use their energy for more efficient waste picking.

4.3.2 Waste pickers' working hours in a day

Three time scales were given in the questionnaire namely, less than five hours, 6-10 hours, and more than 10 hours. Based on the Figure 4.20, no waste picker work from 0-5 hours in Jeram and Dengkil meanwhile 30% worked less than 5 hours in Bukit Beruntung. This is because the waste pickers who worked in Jeram and Dengkil were full-time workers. They spend long hours to earn their main income compared to those who worked in Bukit Beruntung with the majority being part-timers. The part-timers have other jobs and working in landfills was only a way for them to earn some side income.

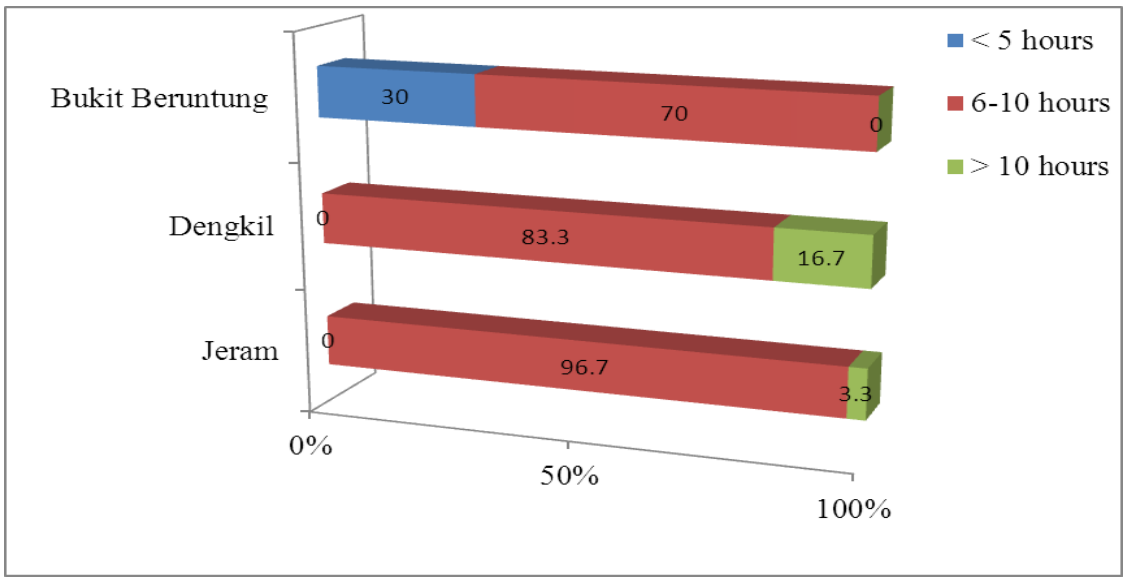

Figure 4.20: Waste pickers' length of scavenging hours in a day

Waste pickers who spend 6-10 hours scavenging in the landfill were 96.7% in Jeram, 83.3% in Dengkil and 70% in Bukit Beruntung. The majority of waste pickers in all three landfills spend 6-10 hours to scavenge the recyclables depending on the time allocated from morning to the evening with break at night. They chose to rest at night with their family. In addition, landfill management also does not allow them to work at night to avoid any unwanted incident. However, there were also waste pickers who work more than 10 hours. This was recorded at 3.3% in Jeram and 16.7% in Dengkil. This is likely because the waste pickers were eager to earn more and want to increase their income regardless of the risk in the dark. Such extended working hour should only be allowed with proper monitoring by the landfill management. Although the waste pickers spend long hours at landfills, most of the time spent is standby time as they are usually most active only when the garbage trucks arrive. The rest of the time is usually spent under shelters as indicated in Plate 4.10.

Plate 4.10: Waste pickers standing by under shelters during the survey

According to research done by Seow (2012), waste pickers in Johor also spend 1 to 15 hours per day for work. Most of waste pickers there spend the productive period of their

lives at the landfill while others work there temporarily when unable to find employment in the labor market. The waste pickers in Bukit Beruntung may have ordinary jobs such as gardeners, house wife, and cleaners. This findings are similar to the research done by Seow (2012).

From the analysis in Table 4.4, it is discovered that the minimum working hour per-day was seven hours for respondents from Jeram, while the maximum was 11 hours giving a mean of 8.97 hours. In Dengkil, the minimum working hour per-day was seven hours, while the maximum was 12 hours, which means value reached 9.07 hours. Meanwhile, in Bukit Beruntung, the minimum working hour per-day was four hours, while the maximum was 10 hours, and the mean was 6.7 hours. This is most likely because most of the respondents in Jeram and Dengkil were full time waste pickers whereas most of the respondents in Bukit Beruntung were part time waste pickers.

Table 4.4 Average durations of waste pickers' working hour

	Jeram sanitary landfill	**Dengkil non sanitary landfill**	**Bukit Beruntung open dumping**
Mean (hour)	8.97	9.07	6.70
Minimum (hour)	7	7	4
Maximum (hour)	11	12	10

4.3.3 Waste picker's opinion on working in landfills

Waste pickers' level of comfort while working in the landfills was also studied. 93.3% of respondents in Jeram, 83.3% in Dengkil and 73.3% in Bukit Beruntung stated that they were comfortable working at the landfill. Meanwhile, only 6.7% of waste pickers in Jeram, 16.7% in Degkil, and 26.7% in Bukit Beruntung were not comfortable

working at the landfill. Nevertheless, majority of the waste pickers indicated that they were comfortable working at the landfill. This is because they were free to determine their working time and does not require specific skills in doing the work. Those who stated otherwise mainly because the landfill has bad smell and can be too hot during day-time. Foreigners in landfills feel comfortable working in the landfill because there was no interference from the authorities.

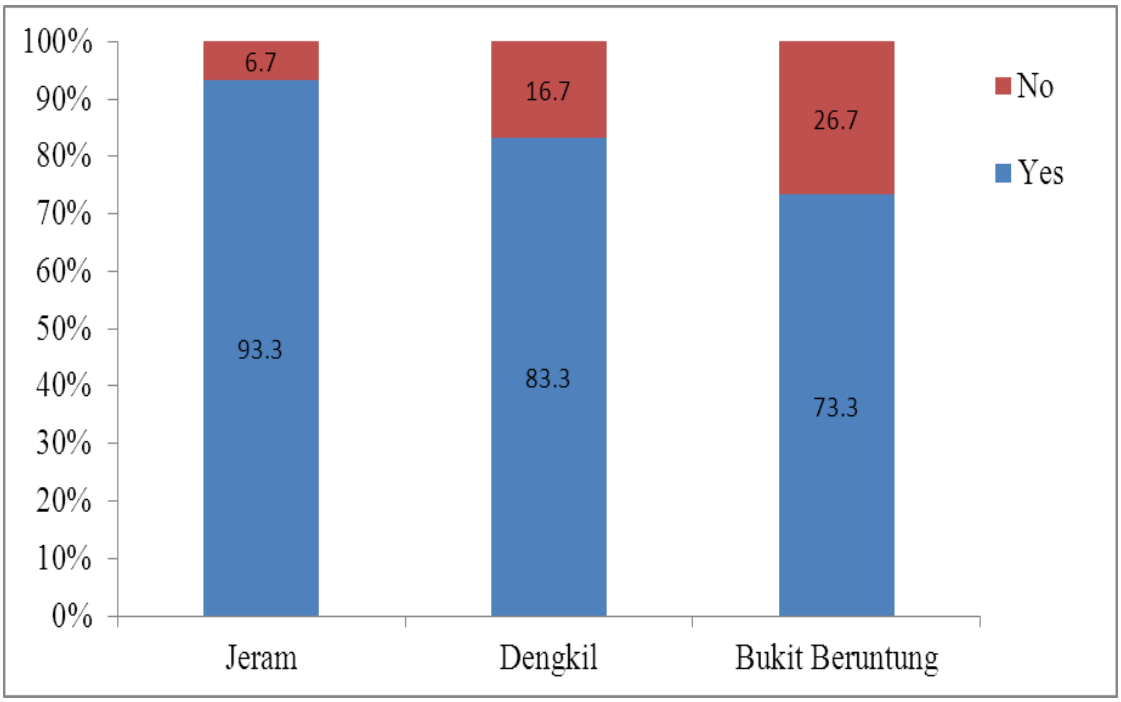

Figure 4.21: Waste pickers' comfort while working in the landfills

4.3.4 Waste pickers ' opinion about fatigue

In this study, waste pickers' tiredness from work was studied too. Figure 4.22 shows 83.3% of waste pickers in Jeram, 90% in Dengkil and 70% in Bukit Beruntung stated that they felt exhausted after their work. This is resulting from the very hot weather conditions and also probably due to the release of methane gas. However, 16.7% of the waste pickers in Jeram, 10% in Dengkil and 26.7% in Bukit Beruntung did not feel tired at work. This probably because they have strong stamina and used to work heavy.

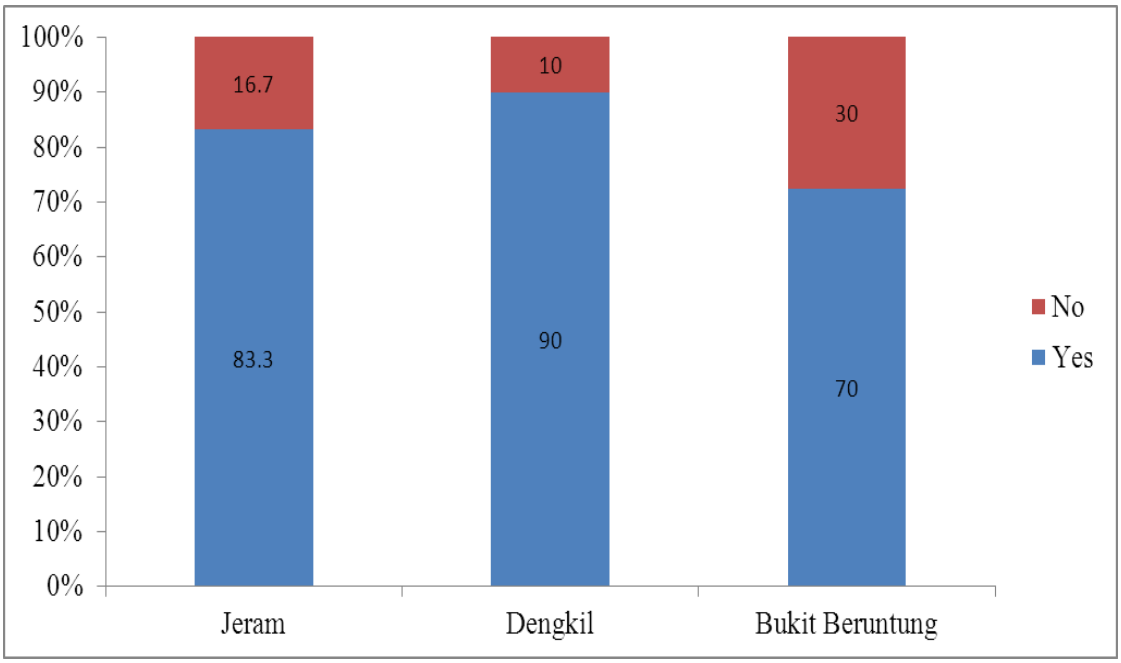

Figure 4.22: Opinion on fatigue after working as a waste picker

To cope with fatigue, the waste pickers construct temporary shelters for them to take shade under when the heat gets too unbearable, rest when they experience tiredness or fatigue, or sometimes to pray, eat, and nap (Plate 4.10).

Plate 4.11: Temporary shelters constructed at landfills

4.3.5 Waste pickers experience on health problems

The relation between the waste pickers' work and health was studied. 30% of waste pickers in Jeram, 43.3% in Dengkil and 56.7% in Bukit Beruntung suffered health problems while working in the landfill. 70% waste pickers in Jeram, 56.7% in Dengkil and 43.3% in Bukit Beruntung do not have health problems. In general, the majority of them do not suffer from any critical illness since they work in the landfill. It is possibly due to a high immune system among the majority of the waste pickers, namely the Madurese. The landfill management also claimed that Indonesians and the native people were used to work hard and tend to be more resistant to diseases. This is unlike previous workers from Nepal, Myanmar and Bangladesh hired by the management that fall sick easily and have to be transferred to other sectors. The management also said that the waste pickers rarely complained about their health and rarely asked to be brought to clinic or hospital. Those who are sick will usually tend to their sickness themselves.

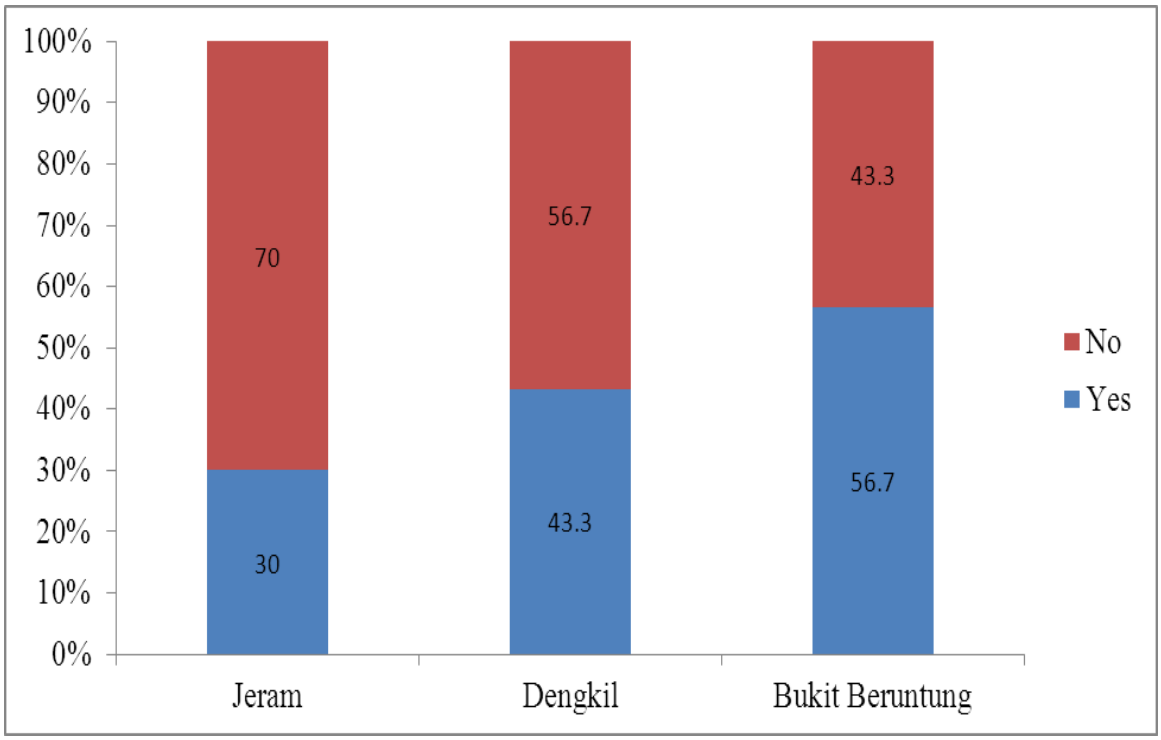

Figure 4.23: Experience of health problems among the waste pickers in the landfills

4.3.6 Type of health problem suffered by waste pickers in each landfills

It was found that 26.7% waste pickers in Jeram, 66.7% in Dengkil and 46.7% in Bukit Beruntung had experienced dizziness and fever. Waste pickers who have lung disease in Jeram were 3.3% while in Bukit Beruntung 3.3% have chronic disease. Majority of respondents only experienced health problems like dizziness, fever and body aches. Dizziness and fever were more usually suffered by them because the landfill is hot. Additionally they sometimes consume the edibles found and frequently eat without first cleaning their possibly contaminated hands (Plate 4.12). Although this practice has been commented several times by the management but they have so far failed to take note. Figure 4.24 shows the health problem suffered by waste pickers since they started working.

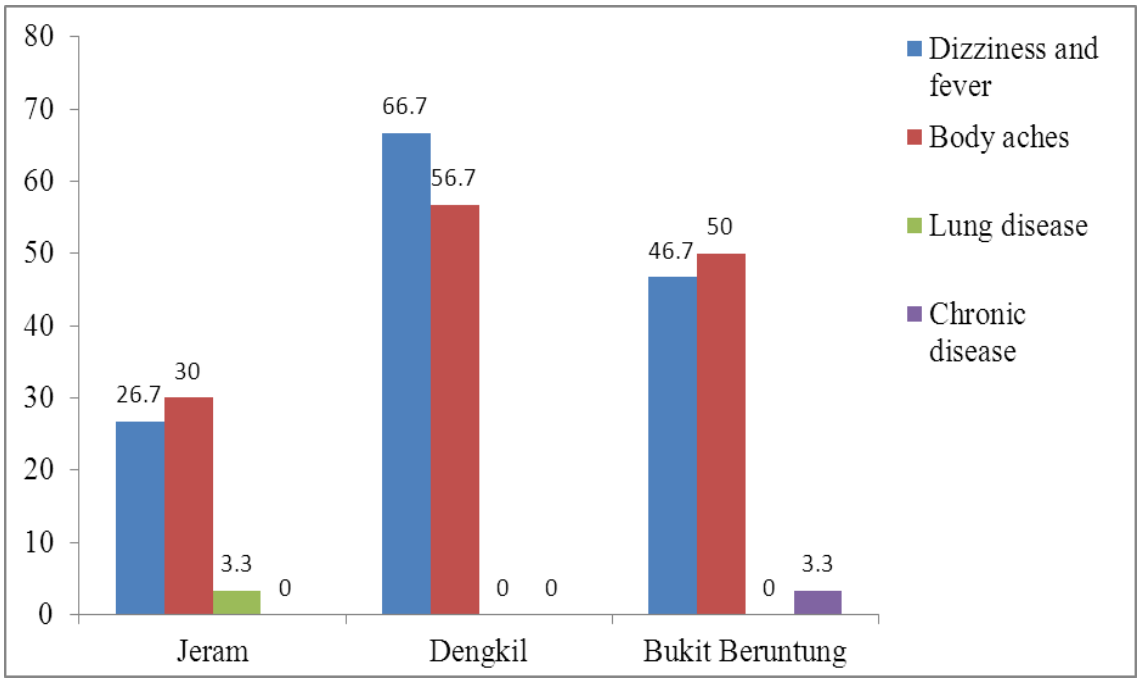

Figure 4.24: Health problem suffered by the waste pickers from each landfills

Plate 4.12: Edibles found in landfills will be consumed by the waste pickers

Wrong working postures, especially when picking up heavy waste objects (Plate 4.13) can lead to body aches and injury. These factors caused waste pickers to suffer from various health problems. Others were the unpredictable weather, not getting enough rest and exposure to various bacteria or pathogens. Infectious diseases can be spread either by direct contact with the waste or through animals such as insects, birds, goats and cows, or by air.

In addition, during the degradation process of the waste, gases such as $SO_{2,}$ NO_X, Dioxin, Sulphur, CO, Ammonia and other gases were released into the atmosphere. These gases can enter human body and react with various cell to harm the individual. This will potentially lead to chronic disease such as Hepatotoxicity, Nephrotoxicity, Pulmonary toxicity, Neurotoxicity, Immunotoxicity and other chronic disease (Robin, 1993).

Plate 4.13: Activities that does not follow safety rules can result to injury and pain

The diseases some of them already have could prolong without the immediate and proper treatment from medical professionals as the waste pickers were constantly exposed to pathogens in their work place. The situation could be a lot worse, especially when the waste pickers have a history of serious illness like asthma, acute allergies etc. From results found in Johor, the common disease suffered by waste pickers are hypertension (17 cases), diabetes (13 cases), asthma (14 cases), heart disease (8 cases), skin disease (2 cases), kidney disease (2 cases), cancer (2 cases), HIV/AIDS (1 cases) and others (15 cases) (Seow, 2012).

Symptoms most regularly seen and reported in others researches are fever, influenza-like symptoms, pulmonary disorders, organic dust-like symptoms, gastrointestinal problems, eye inflammation and irritation of the skin and upper airways (Harrison and Hester, 2002). Manas *et al.*, (2005) reported that waste pickers in India had higher

prevalence of both upper and lower respiratory symptoms, diarrhea, fungal infection and ulceration of the skin, burning sensation in the extremities, tingling or numbness, transient loss of memory, and depression. Then the exposure to bacteria, viruses, endotoxin, and helminthes eggs while doing handling garbage could also lead to an increased risk of gastrointestinal symptoms and irritations of the eye and skin (Poulsen et al., 1995).

4.3.7 Waste pickers & vaccination

From the Figure 4.25, it can be seen that none of the waste pickers from Jeram have had vaccine injections given to them. Meanwhile in Dengkil, 13.3% did receive the proper injection, as do 3.3% of waste pickers in Bukit Beruntung. These injections were essential in preventing the waste pickers from contracting harmful diseases from their working environment. The management of the landfills has stated that the vaccination of the waste pickers is not their responsibility. However, it would be good if the injections are made compulsory for waste pickers, while the management of the landfills plays the role to handle it.

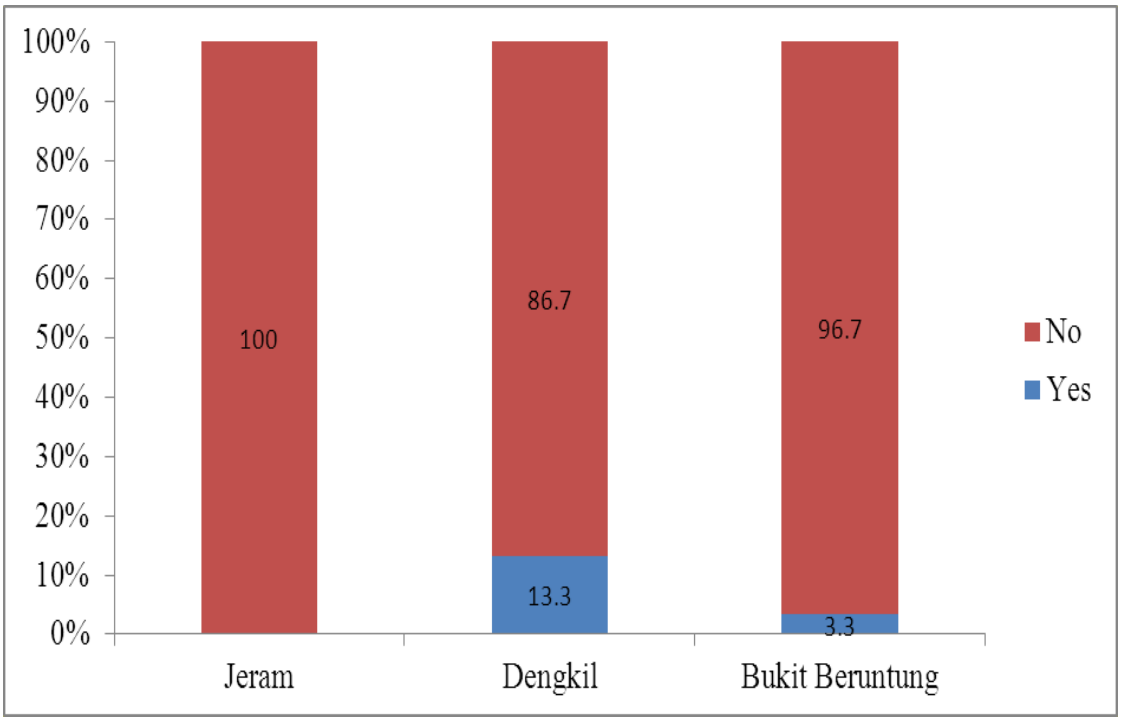

Figure 4.25: Vaccination among waste pickers in landfills

4.3.8 Problems face by waste pickers in landfills

Problems faced by waste pickers while working in the landfill were also studied. In this study waste pickers were allowed to choose more than one options. Among the most common problems encountered were hot weather, foul odor and exposure to sharp objects. The biggest problem was heat as indicated by waste pickers from Jeram (83.3%), Dengkil (73.3 %) and Bukit Beruntung (60 %). This is because Malaysia is located in the equatorial zone that experiences hot and humid weather throughout the year. The warm atmosphere was caused by the sun and also the release of methane gas that causes the air above the landfill to be hot. The next largest problem was foul odors as admitted by waste pickers in Jeram (80 %), Dengkil (60 %) and Bukit (50 %). The landfill receives various types of wastes from home, industry or others giving a variety of composition in the landfill. Thus, the mixture of different types of waste will produce foul odor. Foul odors happen due to anaerobic decomposition of the readily

decomposable organic components found in MSW. They degrade in warm climates and generate odour (Lehmann, 2007).

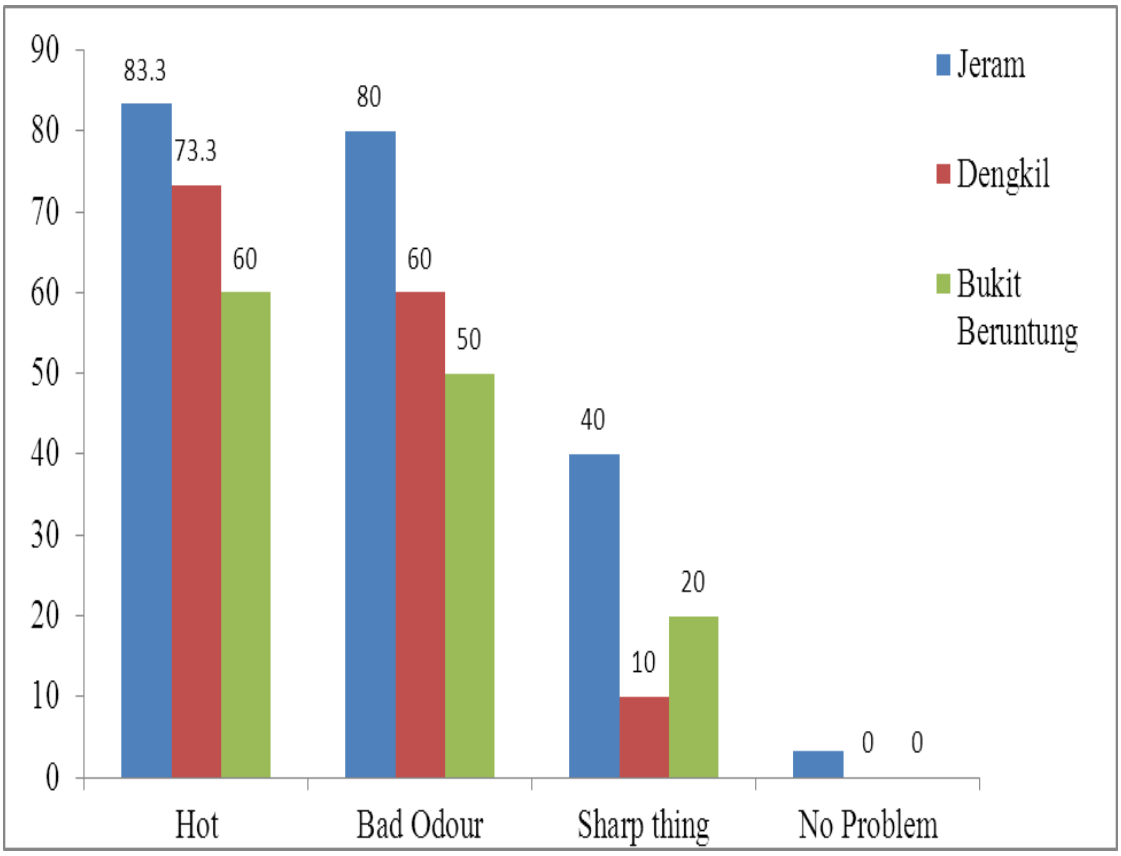

Figure 4.26: Waste pickers' opinion on the problems they face while working in landfill

In addition, sharp objects also pose a problem to the waste picker. In Jeram, 40% of respondents indicated that sharp objects give them problems while it was only reported by 10% in Dengkil and 20% in Bukit Beruntung. Sharp objects are not only harmful because the waste pickers do not use PPE, but also because they can spread unwanted diseases such as HIV and AIDS. Sharp objects identified were needles, knives or rusted metal sheet.

4.3.9 Waste pickers ' experiences on accidents in landfills

Accidents occurred in landfills were also studied. 6.7% of waste pickers in Jeram, 20% in Dengkil and 3.3% in Bukit Beruntung have witnessed or been involved in accidents in landfills, particularly involving garbage truck. Comparatively, in the three landfills, Dengkil recorded the highest incidents among waste picker. This is likely because the type of waste accepted in landfill Dengkil was mostly garden waste with low volume of recyclables. Therefore waste pickers fight with each other to get materials that can be recycled. In fact, such an incident did occur during the study (Plate 4.14).

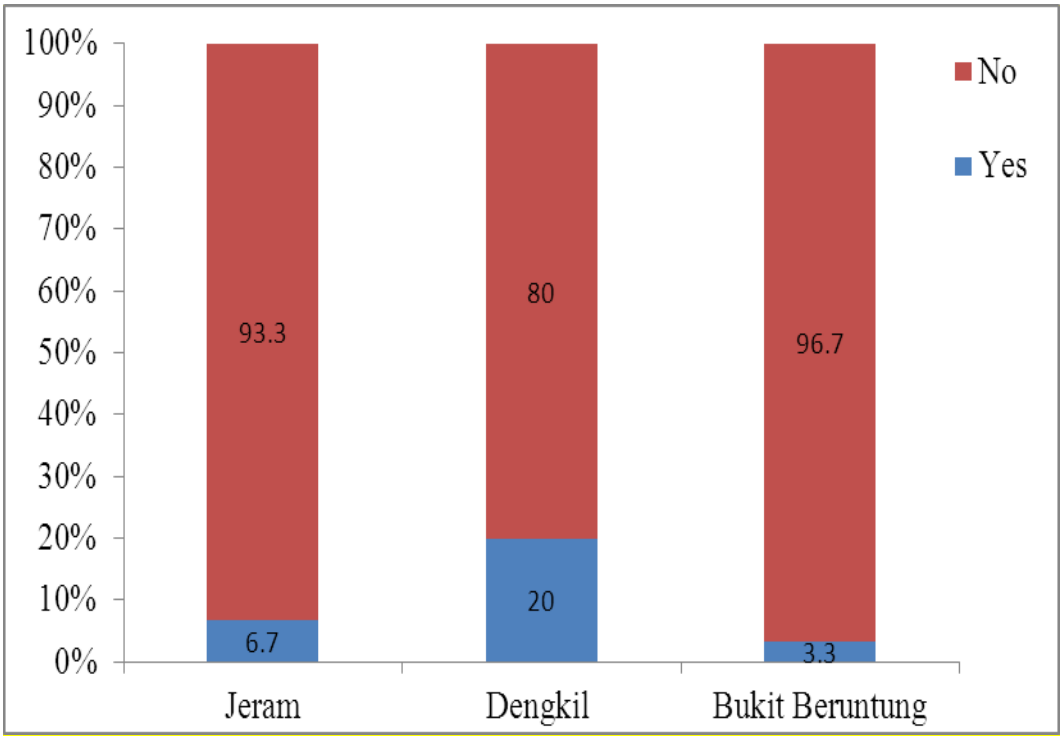

Figure 4.27: Waste pickers who had seen or been involved in an accident at the landfill

Plate 4.14: Waste pickers scrambling over waste materials without regards to heavy vehicles nearby

4.3.10 Types of animals commonly found in landfills

Based on the percentage in Figure 4.28, the animals often found in the three landfills are flies, cockroaches, rats and dogs. Animal and insects such as flies, cockroaches, and rats were common pests that breed in dirty places. These animals can carry diseases and give bad impacts for health. Howard (2001) stated that flies spread the squamous metaplasia and Sputum neutrophilia disease.

Cattle found in landfills are owned by nearby community. Cattle and birds were also reported in Jeram and Bukit Beruntung landfills. Also, stray dogs come to the landfill for food. Apart from rats doing damage to the electrical cable at the landfill these animals are also known as biological hazards (Tchobanoglous *et al.*, 1993) because solid wastes contain high levels of parasites including human pathogens (Adeyeba and Akinbo, 2002). These animals not only carry diseases but also disturb the waste pickers

from doing their scavenging in the landfill.

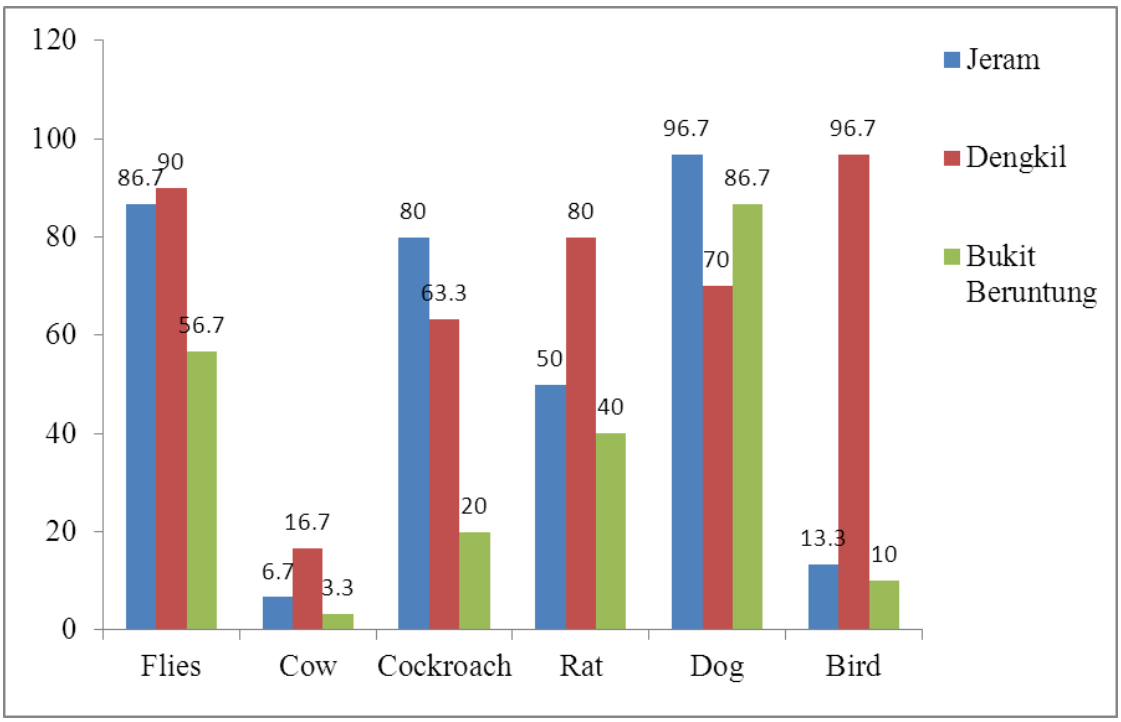

Figure 4.28: Types of animals commonly found in landfills

Plate 4.15: Birds and stray dogs observed in landfill

4.3.11 Waste pickers' opinion on whether animals found in landfills cause problem to them

Figure 4.29 shows waste pickers' opinion whether animal in landfill is a problem to them. In Jeram 13% waste pickers agreed that animals was a nuisance with similar response in Dengkil (3%) and in Bukit Beruntung (70%). The remaining 86.7% waste pickers in Jeram, 96.7% in Dengkil and 30% in Bukit Beruntung stated the animals do not cause a problem to them. This could be the non-citizen in Jeram and Dengkil landfills who were familiar with the animals and they feel that the animals do not give any negative impacts to them. In Bukit Beruntung, most of the waste pickers were school children who might be afraid to do work when such animals are nearby.

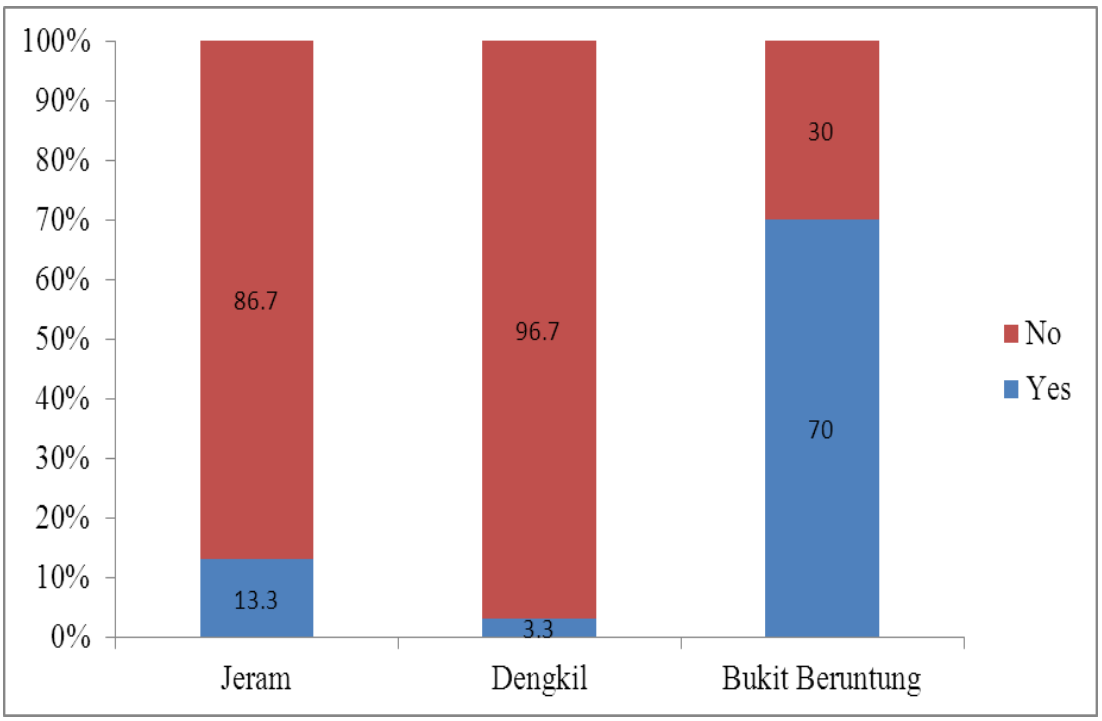

Figure 4.29: Waste pickers' opinion on whether animals found in landfills pose problem to them

Waste pickers in Dengkil and Jeram, seem to be so unaware of the fact that pests can spread diseases that they treat the animals including the pest with little regard or care.

4.3.12 Provision of personal protective equipment (PPE) by the employer

Figure 4.30 shows the responses to question on the provision of personal protective equipment by the employer. Waste pickers who stated that their management provides personal protective equipment in Jeram were 3.3%, 20% in Dengkil and 6.7% in Bukit Beruntung. The remaining majority indicated that their management does not provide personal protective equipment. According to the management, personal protective equipment was the responsibility of the individual. A considerable number of the waste pickers in Jeram do don PPE when working as indicated in Plate 4.15.

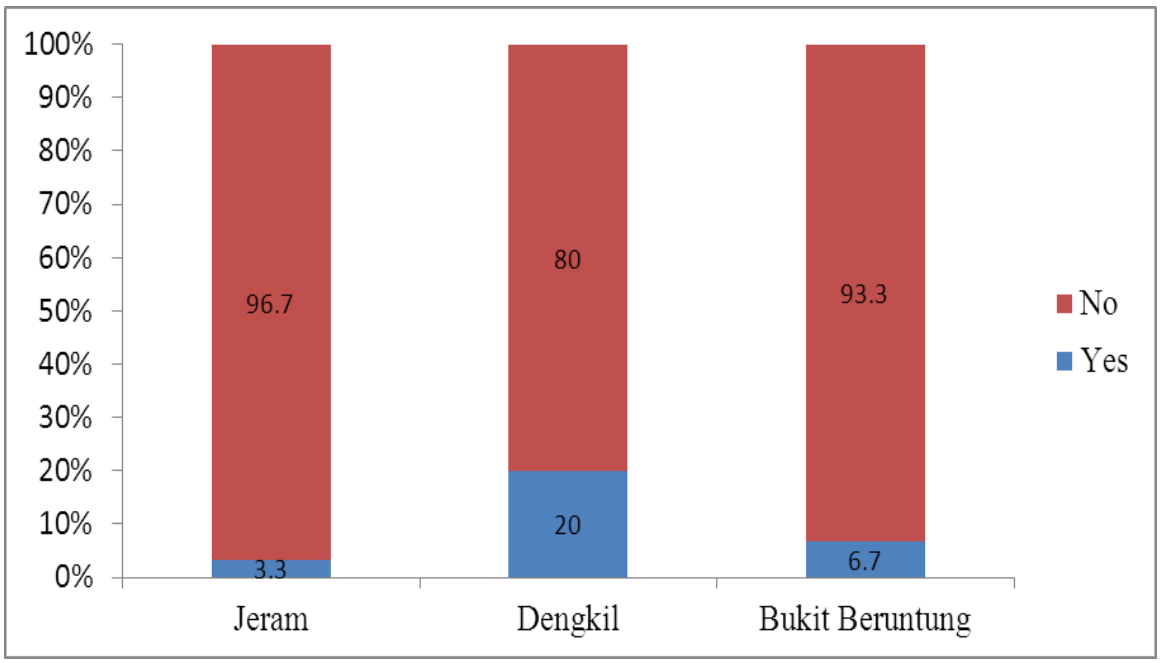

Figure 4.30: Use of personal protective equipment (PPE) in the landfill

Plate 4.16: Absence use of PPE among waste picker in the landfill

The management only monitors that their workers wear protective equipment when working on site. However, from observations, waste pickers at the landfills also did not wear complete personal protective equipment. This is because most of them feel uncomfortable to wear the PPE the whole time. So, they preferred to sort the waste with their bare hands, sticks or simple hooks as indicated in Plate 4.16.

Plate 4.17: Waste pickers not donning PPE

4.4 Part D: Environmental Awareness

4.4.1 Knowledge of recycling among waste pickers

Waste pickers' knowledge about environmental terms was also studied. 73.3% of waste pickers in Jeram, 43.3% in Dengkil and 56.7% in Bukit Beruntung know the meaning of recycling. While 26.7% in Jeram, 56.7% in Dengkil and 43.3% in Bukit Beruntung does not know the meaning of recycling even though they contribute towards recycling. This may be attributed to their low level of education or their disinterest in finding out about current issues or even in trying to understand the term. Those who know the meaning of recycling is likely already accustomed to hearing the word among themselves (Figure 4.31).

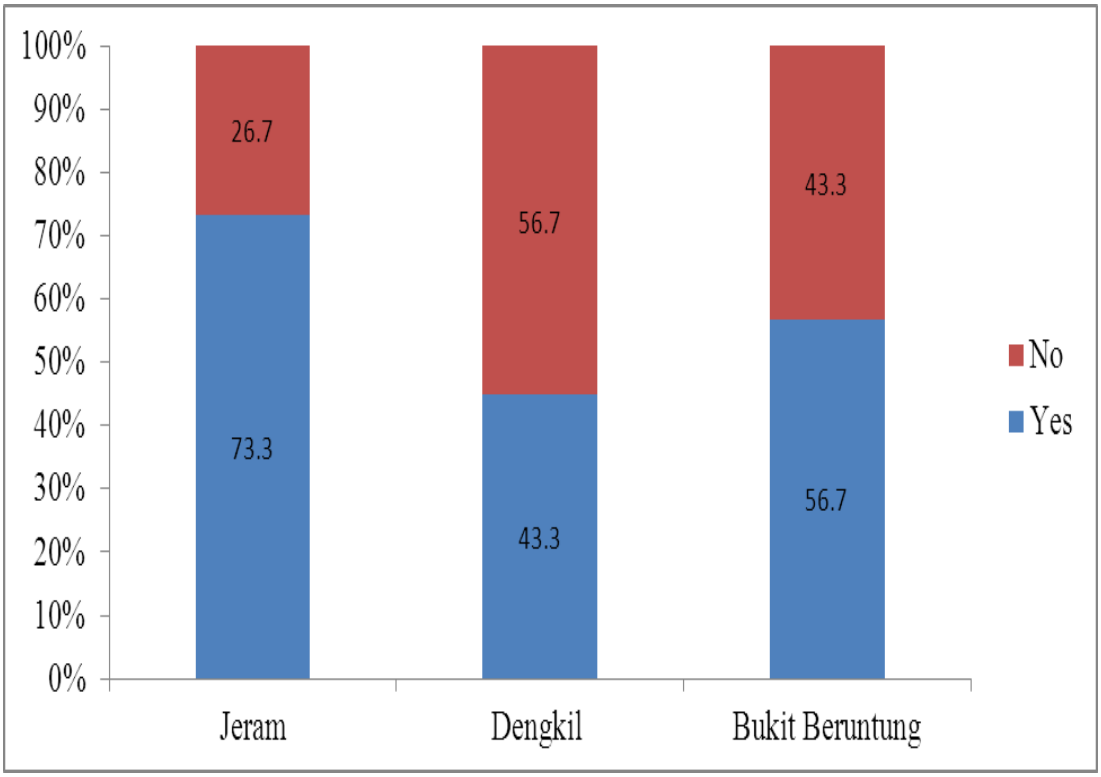

Figure 4.31: Waste pickers who know the meaning of recycling

When waste pickers were asked to describe recycling activities, they did not give detailed definition but mentioned that the activities they were doing was recycling

which is collecting waste and selling them. They were also unable to explain more about the advantages of recycling activities other than it generates income and reduce waste in landfills. Unsurprisingly they are unaware of other of advantages of recycling such as preserving natural resources, reducing the use of virgin materials and generating livelihood for unskilled workers and others (Harrison and Hester, 2002; Agamuthu, 2010). The correlations between the understanding of recycling with waste pickers age, sex and education level were studied. However no significant correlation between age, gender, education level and the meaning of recycling was obtained. When asked by the researcher whether or not they would continue with their recycling activities if they were not paid to do so, all of them responded negatively. To them, recycling for free is a waste of their time and energy as their main reason for recycling is to earn extra income and to support and provide for their family.

4.4.2 Waste pickers' support on recycling activities organized by the government

Figure 4.32 shows percentage of waste pickers' support on recycling activity organized by the government; it was found that in Jeram's landfill 53.3% waste pickers supported recycling activity organized by the government, 90% of waste pickers in Dengkil and 60% in Bukit Beruntung are also in support of this move by the government.

Most waste pickers would support recycling programme organized by the government because they realized that there are a lot of waste materials that waste can be recycled at the landfill sites at present. Their inability to retrieve the whole components of recyclable goods is a loss to Malaysia. Those who support the recycling activities by the government believed that their job is a way to support the government to improve recycling rate in the country. Nevertheless, waste pickers who were involved in waste

picking activity probably were not really to support of the government's effort in recycling but rather to earn an income to support their family.

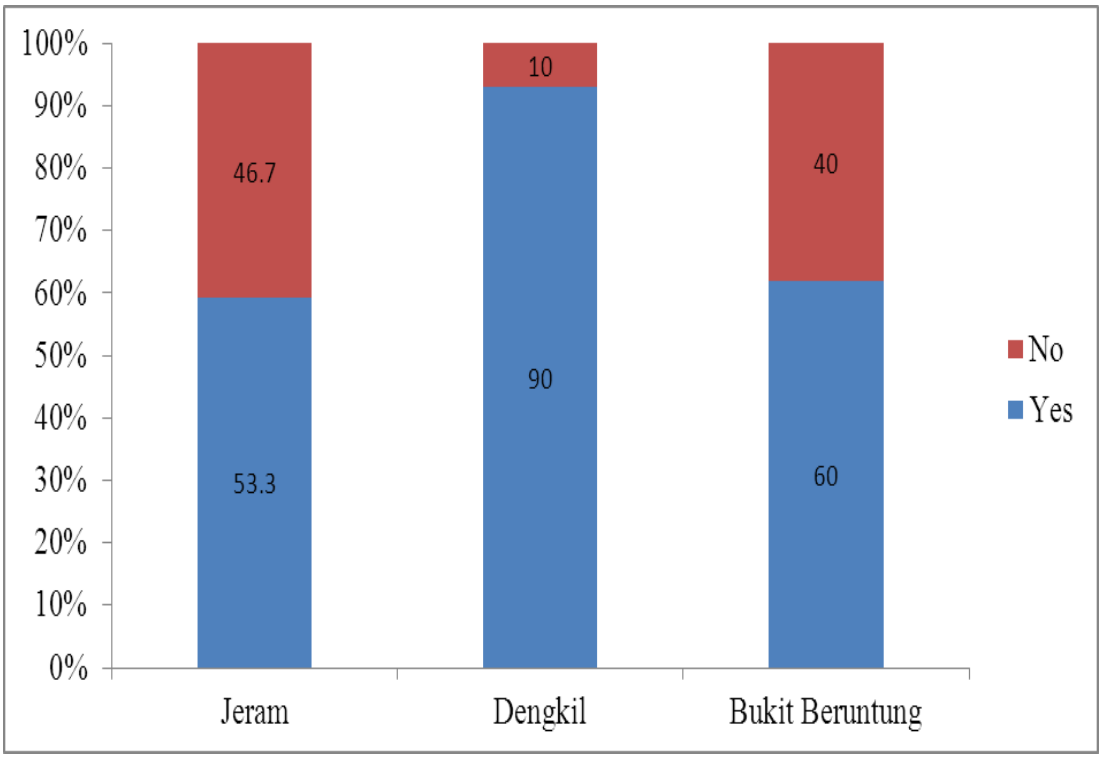

Figure 4.32: Percentage of waste pickers' support on recycling activities organized by the government

Almost 47% of waste pickers in Jeram, 40% in Bukit Beruntung, and 10% in Dengkil do not support recycling programs organized by the government. This is because from their perspective, recycling organized by the Malaysian government was seen as an inconvenient practice and a hassle to them. For them, recycling program should come with adequate facilities for ease of use. There was no significant correlation between the level of education and the support shown by waste pickers to recycling programs carried out by the government. It is highly possible that this was due to their perception that recycling programs will reduce the amount of recyclable materials available in landfills, thus reducing their income. From the interviews conducted, it is found that the waste pickers support the government's recycling activities. However they themselves do not

practice any recycling activities outside landfills. They believed that if recycling activities are widespread in the country the availability of recyclable materials in landfills would be reduced thus making their work less profitable. Therefore waste pickers only involve with recycling activities if they can get benefit. This is because their driving motivation only financial benefit and not in environmental concerns. In addition to that, they have to compete with garbage truck collectors who retrieve the recyclables when they collect the rubbish from household as reported by Zainur *et al.*, (1994).

4.4.3 Waste pickers who practice recycling at home

Based on Figure 4.33, it was found 20% of waste pickers in Jeram, 10% in Dengkil and 36.7% in Bukit Beruntung recycled waste at home. The percentage of those who do not recycle were 80% in Jeram, 90% in Dengkil and 63.3% in Bukit Beruntung, indicating that the majority of waste pickers did not recycle at homes. Waste pickers implied that there were not many things that can be recycled in their waste because they did not purchasing goods often. For them, it was not worth it to collect these items for recycling since earning would be too little. Thus, it is clear that waste pickers were involved in scavenging and recycling materials from the landfill only to earn an income and not because of their environmental awareness.

The correlation between age and waste picker who practices recycling at home was significant (correlation coefficient = 0.045). Older waste pickers recycle at home in order to generate more side-income. However, no significant correlation between gender or level of education and recycling at home was obtained.

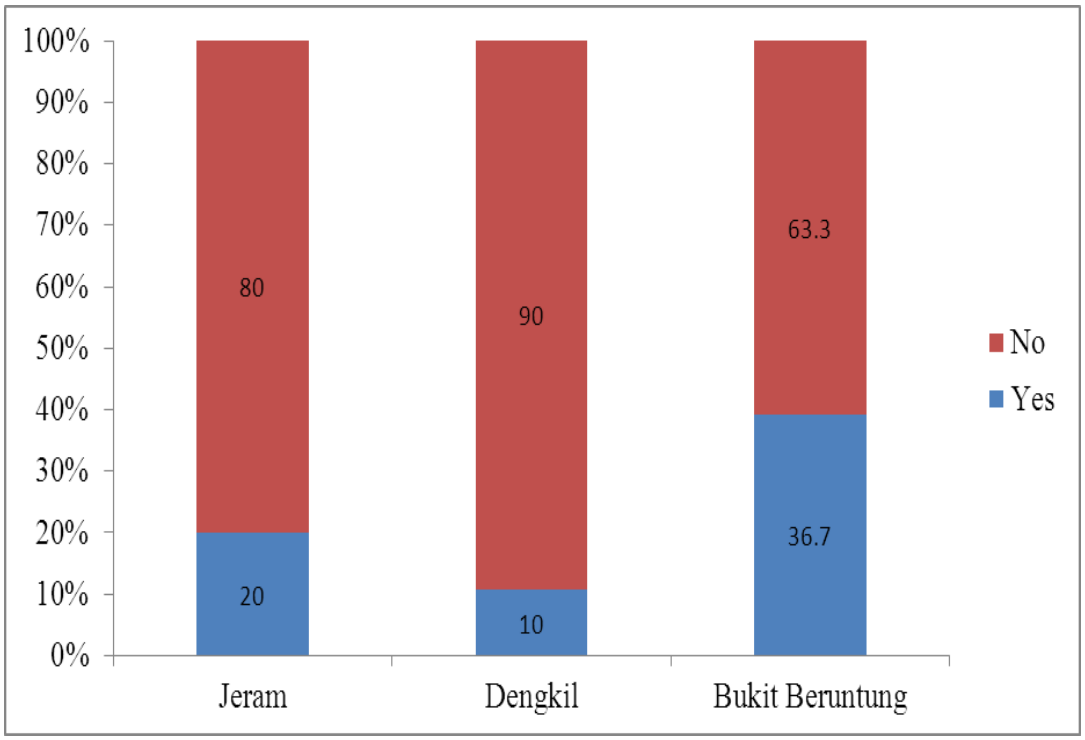

Figure 4.33: Percentage of waste pickers who practice recycling at home

4.4.4 Willingness of waste pickers to send recyclable waste from their home

Waste pickers' willingness to separate waste and send them to a recycling centre despite the distance of the recycling centre was studied. 36.7% waste pickers in Jeram and Bukit Beruntung and 10% in Dengkil were willing to send recyclable waste for a considerable distance to recycling centres. This is likely due to their self-awareness that recyclable wastes should not end up in landfill. Meanwhile, the majority of the waste pickers in the three disposal sites were not willing to send their recyclable waste if recycling centres are far from their homes. Waste pickers in Jeram and Bukit Beruntung recorded 63.3% while in Dengkil it was 90%. This is because the costs of transportation to the recycling centres were higher than what they earn from recycled items.

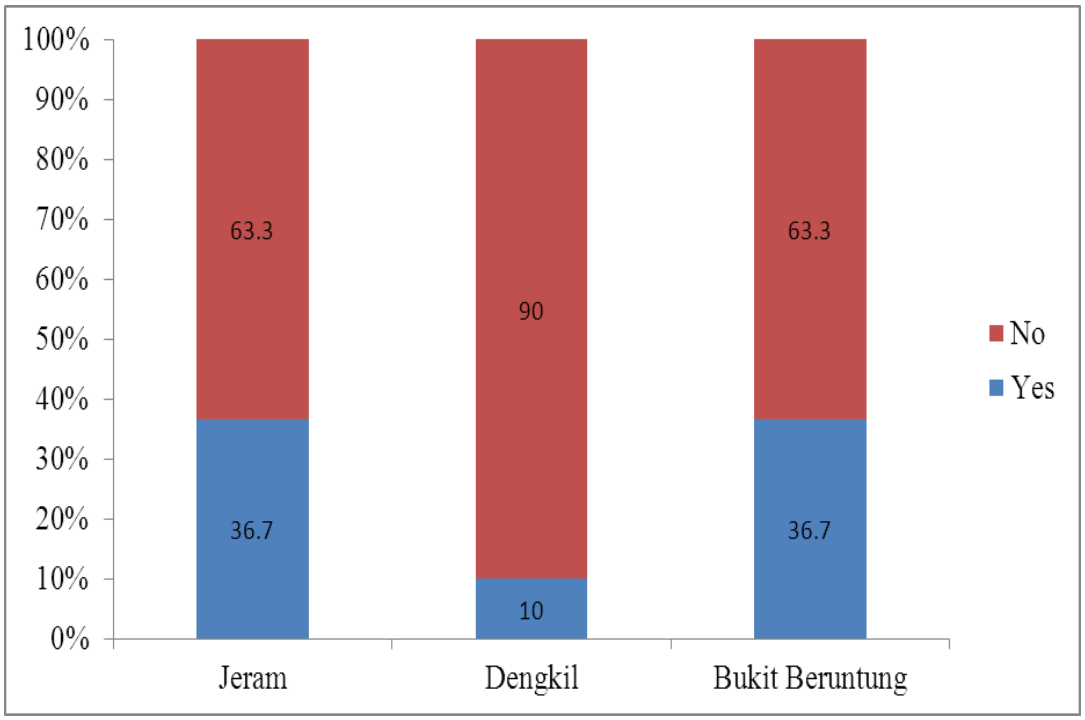

Figure 4.34: Waste pickers' willingness to send recyclable waste from home

4.4.5 Waste pickers' involvement in composting activity

Figure 4.35 shows the percentage of waste pickers who carry out composting, whether in landfills or in their homes. Composting activity involves organic material that can be composted and recycled as fertilizer and soil amendment. No waste pickers in Jeram conduct composting. However, composting was carried out by 3.3% in Dengkil, and 20% in Bukit Beruntung. This is acceptable since composting requires space and specific skills. Since most waste pickers in the landfills do not have the skills, capital and tools, composting is not common among them. Composting also requires for the waste to be separated from the outset, while the waste in landfills that can be composted was mixed (commingled) with uncompostable waste. They used plants that are cut or slash to make compost. Most of them were farmers and gardeners who use the compost as fertilizer for their crops. They do not carry out this composting activity in landfills as there was no space available to carry out composting activities.

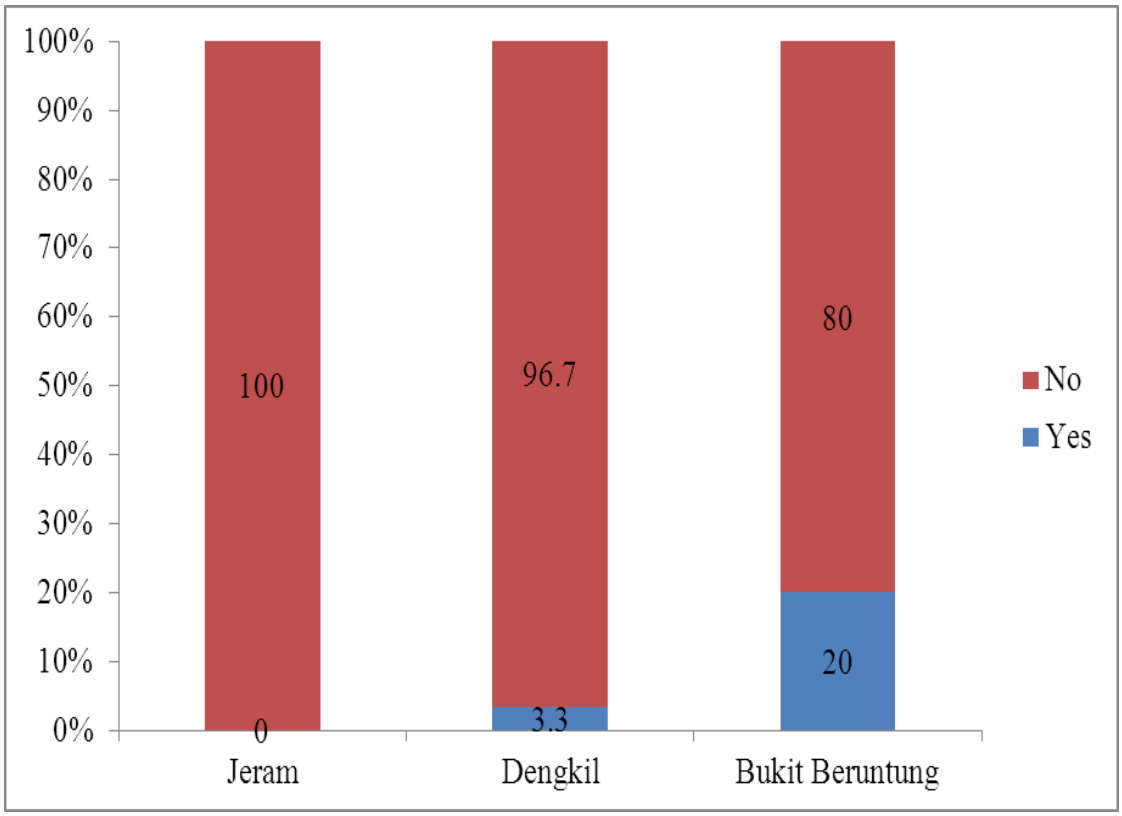

Figure 4.35: Percentage of waste pickers that conduct composting activity

4.4.6 Waste picker's knowledge about biodegradable plastic

Waste pickers' knowledge on the use of environmental-friendly materials was studied including the knowledge on degradable plastic. Figure 4.36 shows the percentage of waste pickers who know about degradable plastic and its advantages and benefits. 36.7% of waste pickers in Jeram, 6.7% in Dengkil and 56.7% in Bukit Beruntung were aware of the use of this plastic. Most of the waste pickers were not aware of the use of degradable plastics. Waste pickers in Jeram recorded 63.3%, Dengkil is 93.3% and Bukit Beruntung 43.3% were not familiar with the use of degradable plastic probably because they were not interested in it. This is most likely brought about by the fact that the average Malaysian is also not very familiar with degradable plastic.

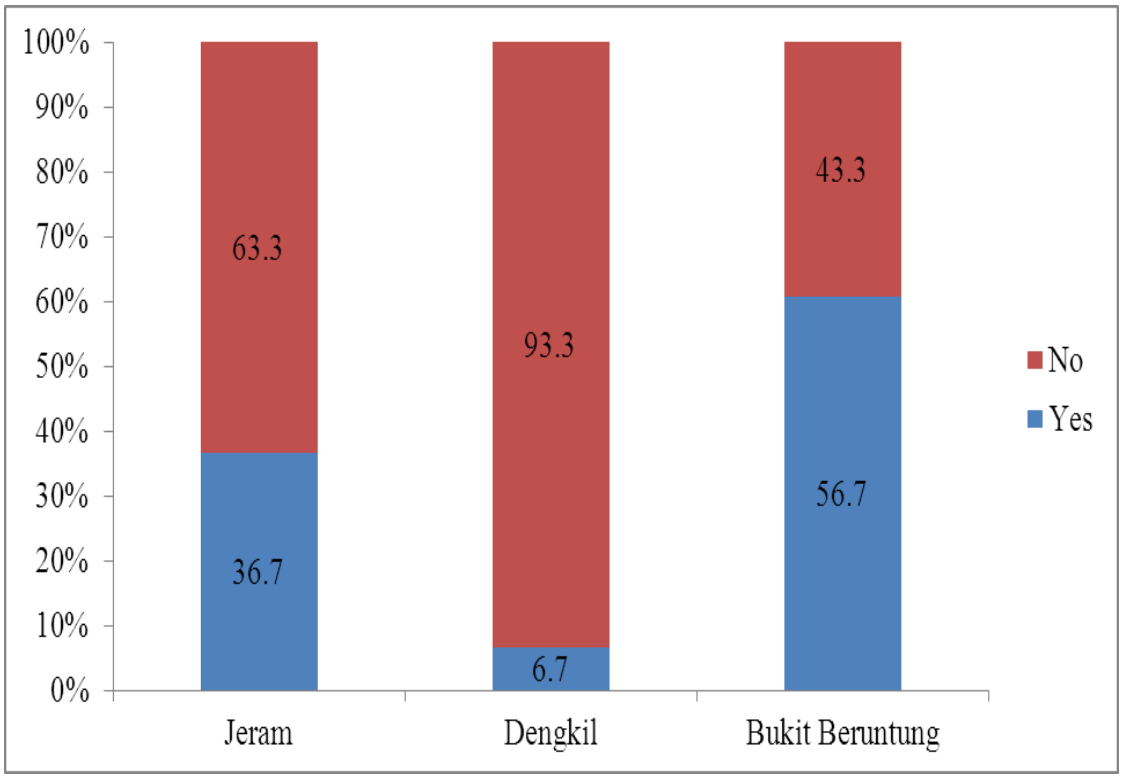

Figure 4.36: Waste pickers' awareness on biodegradable plastic

4.4.7 Waste pickers' support the use of biodegradable plastics

36.7% of waste pickers in Jeram, 10% in Dengkil and 60% in Bukit Beruntung support if the government make the use of biodegradable plastic mandatory to the public. But, there are 63.3% of waste pickers in Jeram, 90% in Dengkil and 40% in Bukit Beruntung who do not support this suggestion. Interestingly, the majority of waste pickers in Jeram and Dengkil were not supportive with the mandatory use of degradable plastic, while majority of waste pickers in Bukit Beruntung support it. This was probably due to the different backgrounds of the waste pickers. Waste pickers in Jeram and Dengkil mostly are non-citizen who lack of understanding about the usage and advantages of using degradable plastic. Meanwhile waste pickers in Bukit Beruntung were locals with most of them understand the benefits of degradable plastic. They were also able to explain how conventional plastic affect the environment.

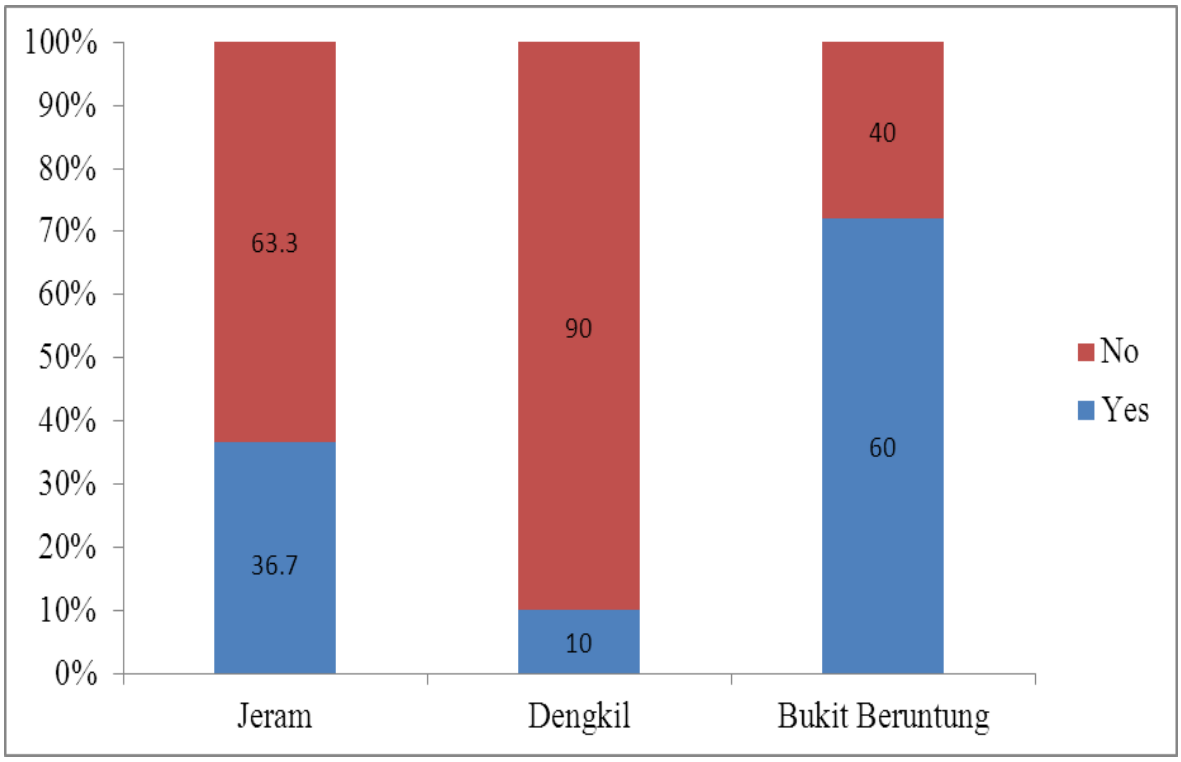

Figure 4.37: Waste pickers' support on the use of biodegradable plastics

4.4.8 Waste picker's knowledge about pollution from waste disposal

Figure 4.38 shows the opinions of the waste pickers on pollution coming from improper waste disposal. Most of them know about the negative impact especially from improper waste disposal. For this question, most waste pickers selected more than one impact of waste disposal to the environment. Majority of waste pickers (60%) in Jeram choose water pollution. Majority of waste pickers in Dengkil (60%) felt that groundwater contamination was more common while the majority of waste pickers in Bukit Beruntung (53.3%) felt that health problems were more serious. Most of them indicated that the impact of waste disposal contributes to water pollution. This is probably because they see for themselves how rivers or water sources are being contaminated by the flow of leachate from landfills. As for waste pickers in Bukit Beruntung who felt that waste disposal causes health problems more probably because most of them have

health problems during their stay in landfill site. They also stated that waste disposal also causes air pollution, bad scenery and smell. The finding is similar to the study by Seow (2012) that waste pickers in Johor knows that solid waste will harm the environment and can bring disease to human beings. But they are lack the knowledge of how waste picking activities can also be hazardous to them.

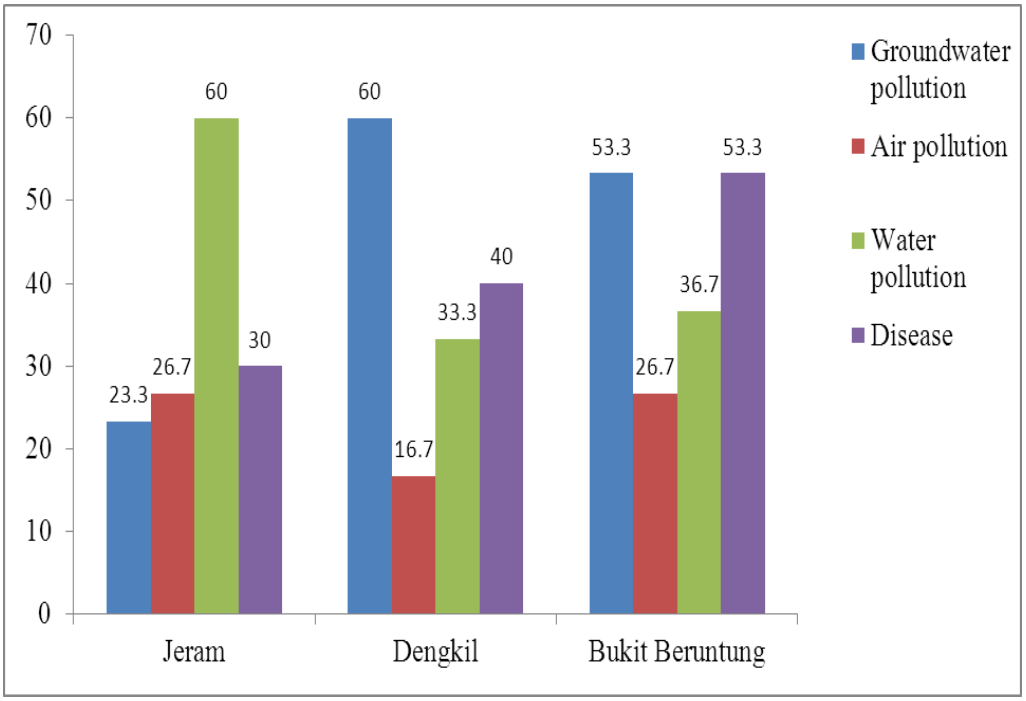

Figure 4.38: Waste picker's opinion on pollution cause by waste disposal

4.4.9 Waste pickers' willingness to buy environmental friendly product

Waste pickers' willingness to buy environmentally friendly products was studied. Only 3.3% of respondents in Jeram, 6.7% in Dengkil and 16.7% in Bukit Beruntung were willing to buy environmental friendly products, even though the charges were quite expensive. But as much as 96.7% of waste pickers in Jeram, 93.7% in Dengkil and 83.3% in Bukit Beruntung were not willing to pay for environmentally friendly products due to their expensive charges. This is because they are from low and middle income groups. They have to place priority on the daily needs of their family. Most of them also

indicated that money is more important for their survival than buying products solely for the concern of the environment. Thus, generally most of the waste pickers were involved in this activity for their livelihood rather than for the love of the environment.

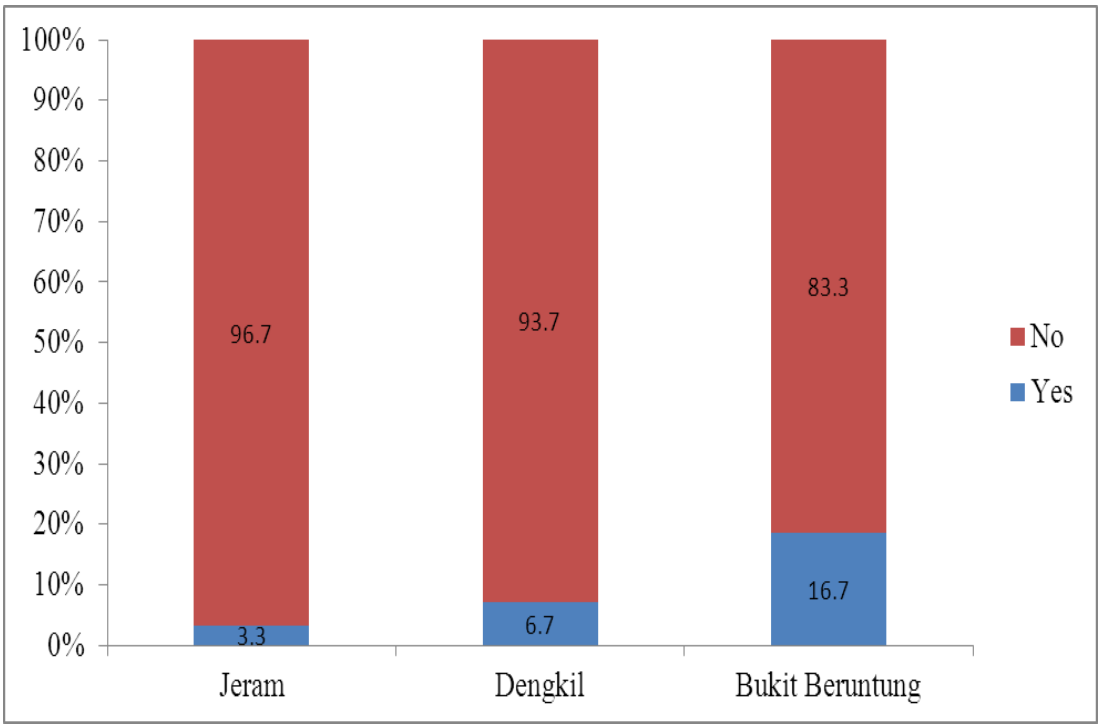

Figure 4.39: Percentage of waste pickers' willingness to buy environmentally friendly product

4.4.10 Waste pickers' opinion about environmental awareness among Malaysians community

The waste pickers' opinion about environmental awareness among Malaysians community was also investigated. About 60% of waste pickers in Jeram, 76.7% in Dengkil and 53.3% in Bukit Beruntung admitted that Malaysians lack of awareness on environmental issues. This is likely from their observations during the work at landfill sites and found many valuable items being discarded that are in fact still fit for use. Also, it is because most Malaysians continue to dump hazardous waste materials like batteries, syringes, expired medications, and others without any regards to the

environmental impact these materials may have as indicated in Plate 4.17.

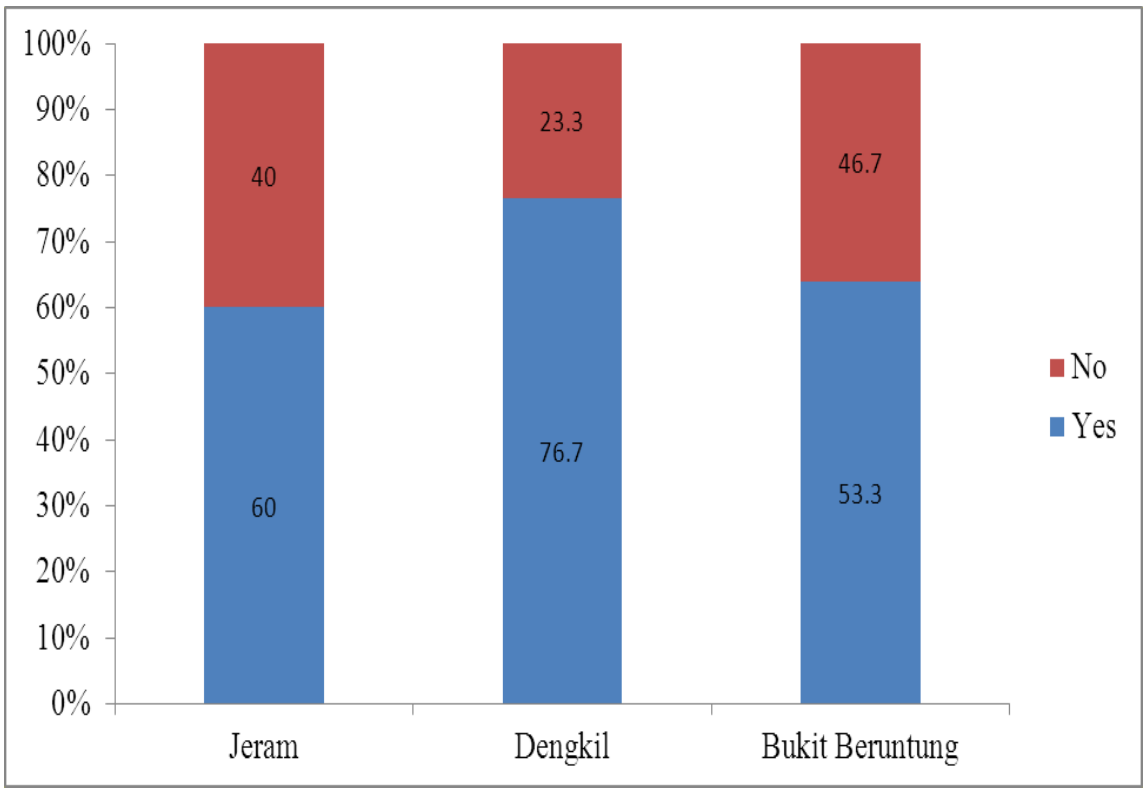

Figure 4.40: Waste pickers' opinion about environmental awareness among Malaysians

Plate 4.18: Medical waste found on a landfill

However, there were also a few waste pickers who disagree with the statement that Malaysians lack awareness of environmental issues. 40% of waste pickers in Jeram,

23.3% in Dengkil and 46.7% in Bukit Beruntung disagreed that Malaysians lack awareness of environmental issues. This is because the waste pickers can see some Malaysians who do take notice of the environmental issues plaguing the country. To them, the existence of experts in various environmental fields is a proof of this.

4.5 Suggestions for further study

Findings from this study will assist in improving the current management of waste pickers in landfills. This study may be extended to investigate the health risks of waste pickers in landfill and the best recommendations for providing the best technical training to the waste pickers. Besides that, further study is also required to help the waste picker community to stabilize their income and benefit the landfill management particularly for in ensuring efficient resource usage and sustainability.

CHAPTER 5

CONCLUSION

Among all three landfills, it is clear that waste pickers in Jeram landfill are gained more profit than to those in Dengkil landfill and Bukit Beruntung landfill. This is dependent on their working hours whether as full time or part time waste pickers and types of landfill they work in. It is discovered in this study that most foreigners choose to work as full time waste pickers as they find it difficult to get employment in other sectors. However, most locals who work as waste pickers do so as a part time job to increase their monthly income.

This study concluded that waste scavenging activities in Malaysia are monopolized by foreigners, especially Indonesians. Employment as a waste picker is less appealing to the local community, having to deal with hot weather, foul odors and a dirty environment. As a result, recycling company operators hire foreign workers to retrieve recyclables materials in the landfills.

Waste pickers do not have a negative view their work. They feel that their job is easier compared to other jobs in other sectors. This is despite the researcher seeing their job as problematic with their existence not being fully acknowledged by the authority, and especially with all the health problems that are often experienced by waste pickers due to being constantly exposed to dirty materials, poisonous gas from waste decomposition process with no tools or clothing for their protection.

Although there are many challenging issues faced by the waste pickers, including low financial gain, occupational risks, health problems and many more, they continue to

perform their work with surprising regularity. The involvement of waste pickers in landfill is not motivated by the love of environment but rather because the job in others sector are not available to them. So the choice to be a waste picker is made only because it is a way to earn income to support their family and their life.

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APPENDIX 1: **Sample of questionnaires**

TITLE: SOCIAL AND ENVIRONMENTAL ASPECTS OF THE WASTE PICKER

PART A: RESPONDENT'S BACKGROUND

1. Gender: _____
2. Age : _____ years old
3. Race: _____
4. Religion: _____
5. Nationality: _____
6. Marital status: _____

PART B: RESPONDENT'S SOCIO-ECONOMIC STATUS

7. Education:_____
8. Numbers of person dependent upon me on support:_____
9. What is your permanent job? _____
10. Do you do scavenging work lonely? _____
11. Why did you choose to work in a landfill?
    High income ( ) Unemployment ( )
    Others: _____
12. How much income per month? _____
13. Is this fixed income? _____
14. Is your income can support your family life? _____
15. Do you get help from any government or non-government agencies? _____
16. How much waste quantity of recyclables material can collect per day?
    _____

17. Type of waste you collect?
    Food waste ( ) Can & Aluminium ( ) Plastics ( ) Wood ( ) Paper ( )
    Others: _____

18. What did you do with your waste collections?
    Sell ( ) Make it as collection ( ) Others: _____

19. To whom you sell the recyclables material?
    Middlemen ( ) Recycling Centre ( ) Others: _____

20. Do you think the charge level is reasonable?
    Too low ( ) Reasonable ( ) Too high ( )

21. Do you have your own house / rent? _____

22. What type of residence?

( ) Shop house	( ) Office	( ) House village
( ) Single storey	( ) Terrace	( ) Apartment
( ) Bungalow	( ) Squatter	

23. What is the distance of your home with the landfill? _____

24. How do you come to the landfill
    Walk ( ) Motorcycle ( ) Bicycle ( ) Car ( ) Others: _____

25. Do you think education is the most important things in the worlds today?
    _____

26. Are you willing to provide education to your children?
    _____

27. Do you want your children to be like you? _____

PART C: OCCUPATIONAL, SAFETY & HEALTH

28. When are you involved in this job? _____

29. How long do you work as scavenger in a day? _____

30. Do you comfortable with your job? _____

31. Do you experience fatigue at work? _____

32. Have you got any disease since you work as scavenger?
    _____

33. If yes, what type of disease you infected?
    Chronic disease ( ) Dizzy & fever ( ) Lung's problem ( ) Body aches ( )
    Others: _____

34. Have you been given any injections during the work on this landfill? _____

35. What is the problem when you do this job?
    Too hot ( ) Smelly ( ) Sharp things ( )
    Others: _____

36. Have you been involved / witnessed the accident due to the fights for lorry? _____

37. What are the animals you usually see in the landfills?
    ( ) Flies ( ) Cockroaches ( ) Dog
    ( ) Cow ( ) Rat Others _____

38. Are the animals giving problems to you? _____

39. If yes, what are the problems occurred?
    ( ) Interferes with work ( ) Give diseases
    Others_____

40. Did your employer provide personal protective equipment (PPE) during your works? _____

41. If yes, what type of equipment they provide? Please state it:
    ( ) Gloves ( ) Safety shoes ( ) Safety helmet ( ) Safety clothing
    Others_____

PART D: AWARENESS OF PRACTICE OF 3R

42. Do you know what is recycling? _____

43. Do you agree recycling organized by the government?
    ( ) Strongly agree ( ) Strongly disagree

44. Do you recycle materials that can be recycled from your house? _____

45. Do you separate the waste based on types? _____

46. I am willing to separate plastic waste, aluminum cans and send them to recycling centers even the center far from my house._____

47. Waste separation at home can increase recycling activity and save space in the landfill. Do you support the separation of waste at home?
    Yes, I support if compulsory. ( )
    Yes, I support but only on a voluntary basis. ( )
    Does not support. ( )

48. Do you practice 'reuse'? _____

49. Do you run the composting of food waste? _____

50. Do you know what degradable plastic is? _____

51. Do you support if the government requires the use of degradable plastic to all? _____

52. What do you think about your job?
    Assist in waste management ( )
    Give trouble to others (society) ( )
    Upgrading of the national economy ( )
    Others: _____

53. What do you think of recycling done by the garbage collector on the street / in the waste disposal area?
    ( ) Ignore them
    ( ) Prevent them from doing the job
    ( ) No reason

54. Your opinion regarding waste management done only by some party? _____

55. In your opinion, what are the consequences of the removal of uncontrolled waste?
    ( ) Groundwater pollution ( ) Water pollution
    ( ) Air pollution ( ) Affect human health

56. Are you willing to buy environmentally friendly products even if the charges are quite expensive? _____

57. Do you agree that the Malaysian society is lack of awareness on environmental issues? _____

APPENDIX 2: **Sample of interview questions**

TITLE: SOCIAL AND ENVIRONMENTAL ASPECTS OF THE WASTE PICKER

1. What is your position in this company?
2. What is your level of education?
3. How much your income per month?
4. How many numbers of person dependent upon your support?
5. How much waste quantity of recyclables material can collect per day?
6. Type of waste you collect/ buy from waste pickers?
7. What did you do with waste that collected?
8. To whom you sell the recyclables material?
9. Do you think the charge level is reasonable?
10. Can you list the price for every item per kg that you buy from waste pickers?
11. When are you involved in this job?
12. How long do you work as waste picker/middlemen in a day?
13. Do you comfortable with your job?
14. Have you got any disease since you work as waste picker/middlemen?
15. Have you been given any injections during the work on this landfill?
16. What is the problem when you do this job?
17. Have you been involved / witnessed the accident due to the fights for lorry
18. Did your employer provide personal protective equipment (PPE) during your works?
19. Do you agree recycling organized by the government?
20. Do you recycle materials that can be recycled from your house?
21. Do you still do this job if you do not get any payment?
22. Do you separate the waste based on types?