Real Data Composition of Municipal Solid Waste (MSW) generated In Balakong, Selangor, Malaysia

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Abstract: Increasing population and rapid urbanisation growth and other factors influence directly the municipal solid waste (MSW) generation in Malaysia. As generally the large quantity of MSW generation, particularly in Peninsular Malaysia, has increased from 16,200 tonnes per day in 2001 to 19,100 tonnes per day in 2005 or an average of 0.8 kg/capita/day. The rate of waste generation in Malaysia is increasing it covers community activities such as commercial, institutional, industrial and markets. Therefore human activities as among of reason why quantity of waste generated increase together with the complexity of waste where plastic and other mixed waste became a very significant portion in the waste stream. It is also related to the economic level of different sectors in the community such as unlawful resident, low, medium and high class residential area. This paper deals with case study of solid waste composition in Balakong, Selangor. The composition of solid waste was studied by segregating it into different components such as paper, glass, plastics, metal, organic waste and others. It was observed that Balakong area produced around 48.07% organic waste which was the highest component compared to other waste, followed by paper, plastic, others, glass, and metal with the value of 29.53%, 16.69%, 2.65%, 1.90% and 1.16% respectively. The areas covered in this study include 8 residential areas, 2 industrial areas, and 1 hypermarket. The study was conducted for 1 month as well as everyday and the data collected was presented in the form of pie chart and table. Thus, the waste generation rate comparison of solid waste generation in Balakong area in 10 days intervals was estimated to 31536.09 kg/day. The current management system is inefficient and recommendation are given to improve the current situation such as to use expert system or others appropriate technology in Malaysia.
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Introduction

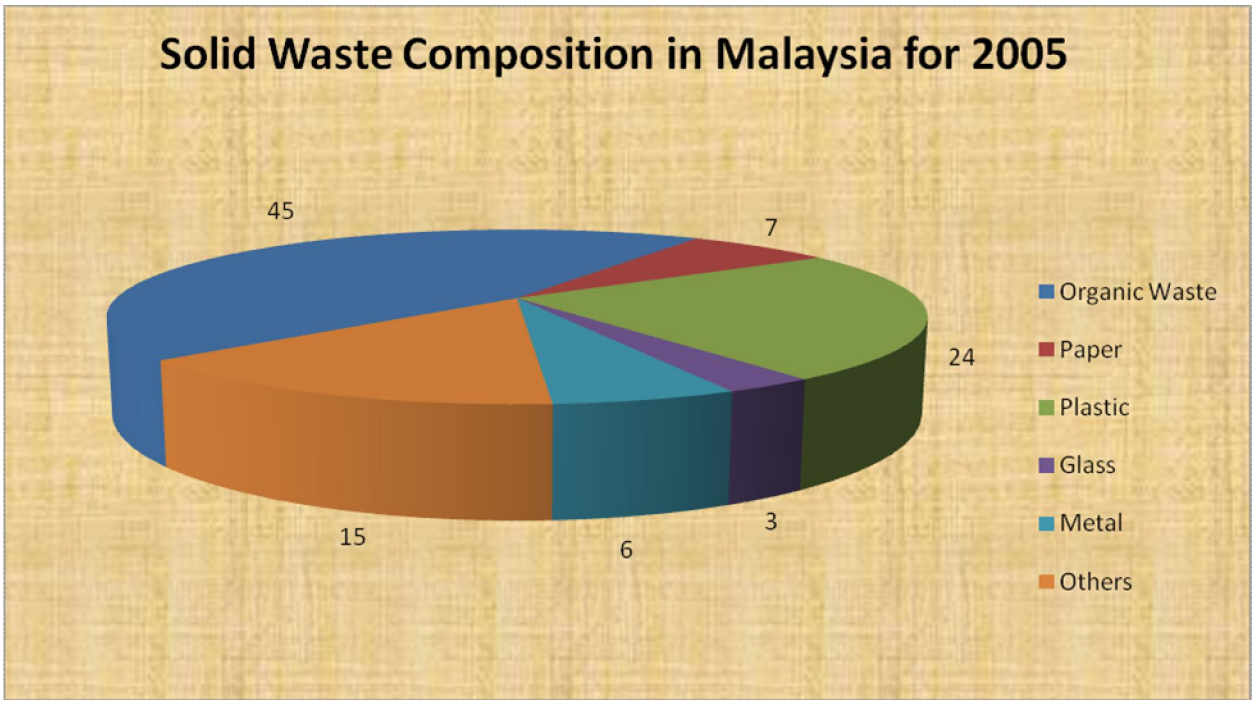
The definition of municipal solid waste (MSW) has been varied among countries in the world. However, in case of Malaysia, solid waste is defined as any scrap material or other unwanted surplus substance or rejected products arising from the application of any process; any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled; or any other material that is required by the authority to be disposed of, and it does not include scheduled wastes, sewage and radioactive wastes (Law of Malaysia, 2007). Therefore, knowledge of quantity and composition of municipal solid waste is fundamental for the planning of waste management system. Most previous studies looked at the characteristics of municipal solid waste at the final disposal sites (Martin et al., 1995, Blight et al., 1999). According to Atkinson and New (1993) with waste management strategies shifting towards more recycling, determining the quantity and composition of waste at the sources of generation is getting more attention and concern. Therefore, in Malaysia according to report by the Ministry of Housing and Local Government, waste generation has been increased gradually since 2000. This circumstance require main focus to be placed on managing the solid waste and mitigating the negative environmental effects (Dawda et al., 2012).

Solid waste generation is the common basis for activity data to estimate emissions from solid waste disposal, biological treatment, and incineration and others activity of waste. Basically solid waste generation rates and composition vary from country to country depending on the economic situation, industrial structure, waste management regulations and life style. The availability and quality of data on solid waste generation as well as subsequent treatment also vary significantly from country to country. Statistics on waste generation and treatment have been improved substantially in many countries during the last decade, but at present only a small number of countries have comprehensive waste data covering all waste types and treatment techniques (IPCC, 2006).

Therefore, the reliable estimates of solid waste generation are very important for proper waste management planning. The real amounts of solid

waste are important for designing appropriate waste treatment and disposal strategy. However, due to the variation in consumption patterns and lifestyle changes, the quantity and quality of waste changes, which is requires the monitoring of quantity composition of municipal solid waste at intervals (Tariq and Mostafizur, 2007).

Types of solid waste in Malaysia generally are divided into 6 categories, namely organic waste, paper, plastic, glass, metal and others. In 2005, according to 9th Malaysia's Plan, organic waste dominates the solid waste stream by 45%, as shown in Figure 1.



(Source: The Economic Planning Unit (EPU), 2006)

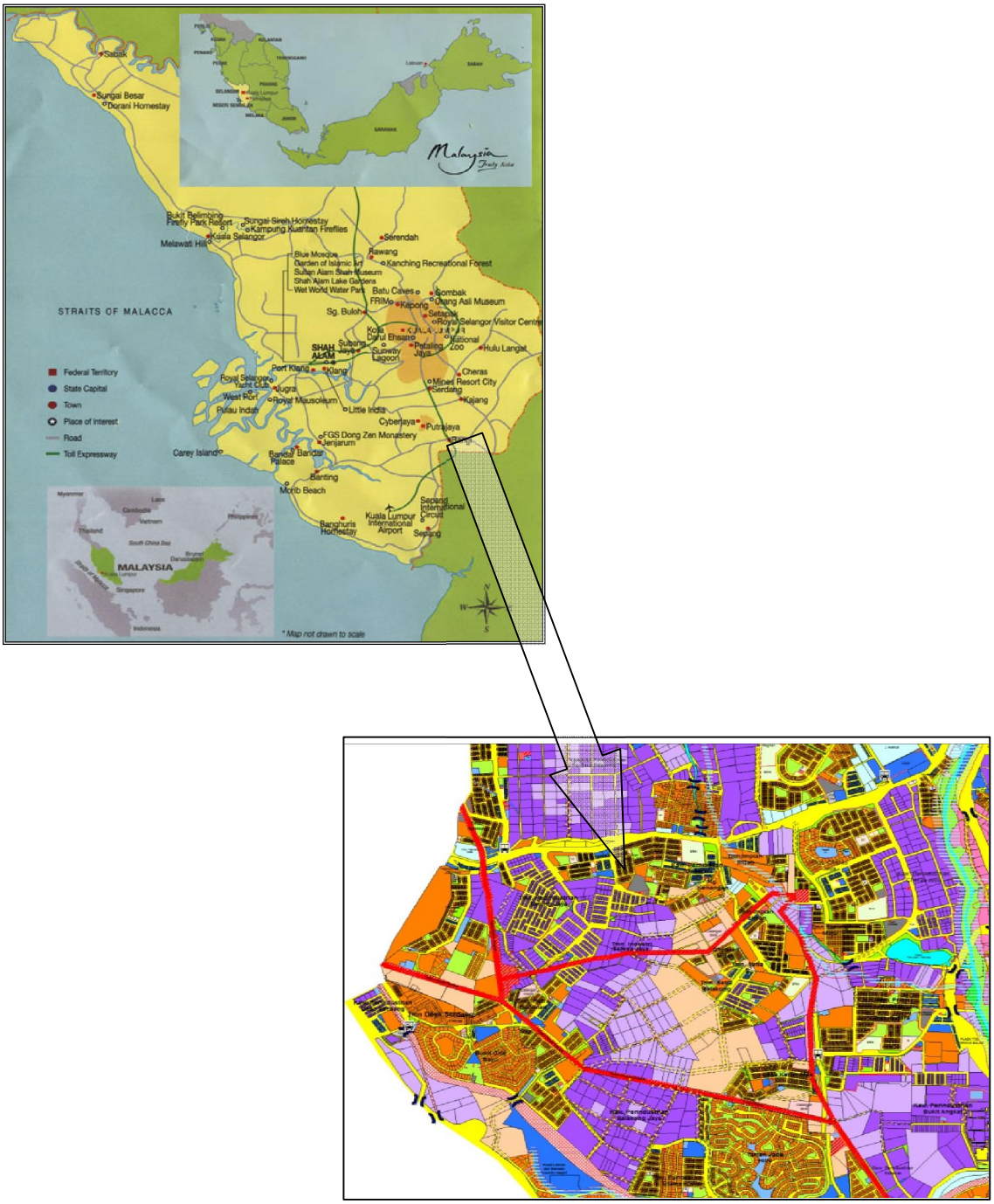
Figure 1: Solid Waste composition in Malaysia 2005

Recent investigations in 2010 resulted information that population of Kuala Lumpur City Area has reached 1.66 million people (JPM, 2009). With the population growth rate of 6.1 percent, then the population in the year 2010 can be estimated at least to 1.69 million people. The waste generation average for a person is 1.2 kilograms per day (Budhiarta et al, 2012). MSW generally disposed by landfilling method or incineration and only a small proportion of the MSW stream (about 2%) is recycled or treated by biological composting (Chen, 2005). Not just that, in Kuala Lumpur, all the MSW collected by the waste collectors are disposed in an open dump landfill. MSW disposal in Malaysia involves the disposal of approximately 98% of the total waste to landfills.

In 2010, the Malaysia's population reaches almost 29 million, and 63.8% is expected to live in urban area (Economy Planning Unit, 2010). With the increase of population and urbanization process, the solid waste generation also will increase. Several case studies have shown this pattern before, especially studies done in highly urbanized areas, such as Pulau Pinang, Johor Bahru and Kuala Lumpur. These studies carried out by government and universities mainly involved wastes generated by households and commercial sources (Local government department, ministry of housing and local government, 2005). The government through Ministry of Housing and Local Government (2005) had expected that based on population growth projections for the period 2002-2020, waste generated at urban areas for 2002 is 14,500 tonnes/ day and increase to 28,200 tonnes/day. With increasing population, disposal problems become more difficult for local authority. Many cities from Asian countries are facing problems regarding on solid waste management (Thitame et al., 2009). Therefore, the study on quantity and composition of Municipal Solid Waste (MSW) will help in deciding a better solid waste management practice for that particular area.

In this study, Balakong area has been chosen, since it consist 3 major producers of MSW, which are

industry, household and commercial. Balakong located between Seri Kembangan and Pekanbatu 9, Cheras, Selangor. Based on map of Blocks of residents in study area are 4,433 residents.. Figure 1 shows the location in Balakon Population and Housing Census of Malaysia 2000 (Department of Statistic, 2011).



(Source: MPKJ, 2011)

Figure 2: Showing sample collection sites in municipal area of Balakong, Selangor.

Material and Method

Basically before research was conducted information regarding waste generation and its quantity and disposal management is essential. Hence, in the present work a few site visit and personnel observation was carried out to choose a

suitable study area consist of residential area, industrial area and commercial. Then, interview were done and official letter regarding to this study were given out to obtain a permission from the owner of the building (household, industry in term of factory and commercial area). After a few weeks observation and interviewed, 8 residential area with 123 houses, two industrial area with 4 factories and 1 commercial area were chosen, as shown in Table 1.

Table 1: Number of respondents based on their areas in Balakong, Selangor

Type of Areas	Name of The Areas	Numbers of Respondents
Residential Area	1.Taman Sri Indah	19
	2. Taman Cheras Jaya	20
	3. Taman Impian Ehsan	19
	4. Kampung Kenangan Indah	14
	5. Taman Setia 2	12
	6. Taman Desa Karunmas	10
	7. Taman Taming Jaya	17
	8. Taman Balakong Jaya	12
Industrial Areas	1. KawasanPerindustrian KampungBaruBalakong	1
	2. KawasanPerindustrianCheras Jaya	3
Hypermarket	1. Jaya Jusco Cheras Selatan	1

Solid wastes generated from this area were separated into 6 categories, namely organic waste, paper, plastic, glass, metal and others. Data were collected for the period of 30 days. For residential area, each participating household was issued with 60 plastic bags, two for each day for 30 days, where one plastic for them to deposit their daily wet waste, and another one for the dry waste. Wet waste mainly consist of food and organic waste, while dry waste were the other composition, such as paper, plastic, metal, glass and others. All solid waste generated from respondents by three different areas were weighed by balance with scale from 0 to 50 kg.

For industrial area and Jaya Jusco Cheras Selatan, quartering method was used, especially for Jaya Jusco Cheras Selatan. Quartering method is used to reducing samples, so that it can possibly weighed by 50 kg scale balance. It reduces samples by mixing, dividing into quarters and keeping two opposite quarters of the same. It also represents the amount of solid waste generated in Jaya Jusco Cheras Selatan. However, in industrial area, this method is seldom used since the solid waste generated can be easily weighed. Data collected than were analyzed to study the composition of solid waste generated in this particular area in term of 10 days basis and the whole period.

Results and Discussion

Table 2 shows the amount (kg) and percentage of solid waste composition in Balakong for one month duration of study.

The waste has been segregated into six groups which are organic waste, paper, plastic, glass, metals, and others.

Table 2: Composition of Solid Waste Generation in Balakong Area per month

No	Waste types	Amount (kg/month)	Percentage (%)
1	Organic Waste	15158.80	48.07
2	Paper	9313.15	29.53
3	Plastic	5263.00	16.69
4	Glass	599.77	1.90
5	Metal	365.24	1.16
6	Others	836.14	2.65
	Total	31536.09	100

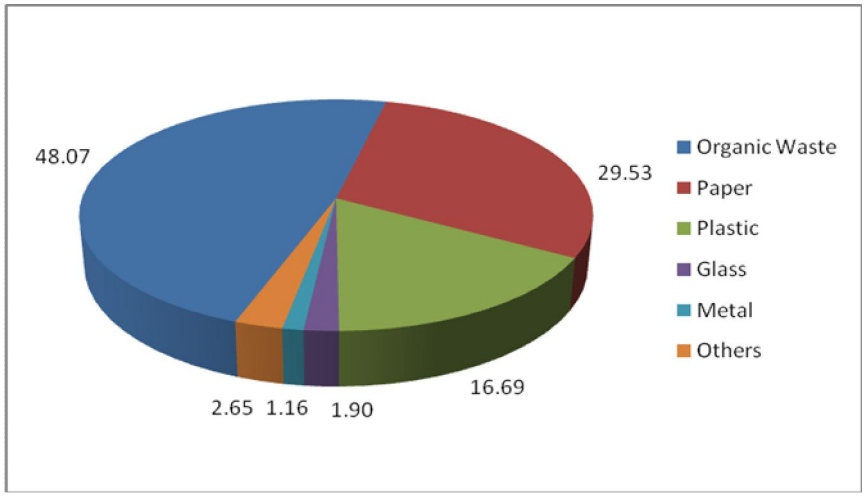


Figure 3: Composition of Solid Waste Generated in Balakong area per month in percentage.

It is observed from Table 2 and Figure 3 that the organic content is the main component of the Municipal Solid Waste quantity, which accounts for 48.07% of the total waste generated in the particular area, or 15158.80 kg from total waste generation. This is followed by paper with 29.53% (9313.15kg), plastic 16.69% (5263.00kg), others 2.65% (836.14kg) and glass 1.90% (599.77kg). The least type of solid waste produced is metal, which accounts only 1.16% from total waste generation with the weight of 365.24kg. The composition obtained is different from percentage of national waste stream in 9th Malaysia's Plan, where the least type of solid waste produced is glass, while organic waste stills the main contributor to the waste stream.

After that, to shows how consistent the data is, and therefore can help indicate how reliably the data can be used to draw general conclusions the standard deviation calculation was used. Standard deviation also shows how far apart different numbers are from the mean (or average) of the entire group of data From Table 2 above the mean of the data was calculated. The mean value is 5256.015 kg. Then, used the mean values to subtract the values from each amount of waste types. Next, square each of the values from step before to find the mean of square values. Lastly, take the square root of the mean to get the standard deviation values. Table 3 below shows the calculation for the sum of the square deviations.

Table 3: Calculation for the sum of the square deviations.

No	Waste types	Amount (kg/month x	$(x - \bar{x})$	$(x - \bar{x})^2$
1	Organic Waste	15158.80	9902.785	98065150.75
2	Paper	9313.15	4057.135	16460344.41
3	Plastic	5263.00	6.985	48.790225
4	Glass	599.77	-4656.245	21680617.5
5	Metal	365.24	-4890.775	23919680.1
6	Others	836.14	-4419.875	19535295.02
	Total	$\Sigma(x) = 31536.09$		$\Sigma(x - \bar{x})^2 = 179661136.6$

Standard deviation is the most common measure of statistical dispersion, measuring how widely spread the values in a data set is. If the data points are all close to the mean which is 5256.015 kg, then the standard deviation is close to zero. This was confirmed by the amount of plastic waste 5263.00kg which is close to the mean value. Then, after subtraction and squared the number the value is not too far from zero. If many data points are far from the mean, like organic waste, paper, glass, metal and other waste then the data point and standard deviation is far from zero. This theory was proved from Table 3 above that shows the data points for these five types of waste after subtraction and squared are bigger than mean value. To complete the calculation of standard deviation the step is the total variance ($\Sigma (x - \bar{x})^2$) value need to be square root of to convert the number back to its original units. Lastly, the standard deviation value for all six type of waste is 13403.77322kg. This value of standard deviation for all six types of waste collected in this study was far from zero because the majority of the data point was far from the mean value.

Table 4: Waste composition (percentage of wet weight) in Malaysia from 1975 to 2005

Waste Composition	1975	1980	1985	1990	1995	2000	2005
Organic	63.7	54.4	48.3	48.4	45.7	43.2	44.8
Paper	7.0	8.0	23.6	8.9	9.0	23.7	16
Plastic	2.5	0.4	9.4	3.0	3.9	11.2	15
Glass	2.5	0.4	4.0	3.0	3.9	3.2	3.0
Metal	6.4	2.2	5.9	4.6	5.1	4.2	3.3
Textiles	1.3	2.2	NA	NA	2.1	1.5	2.8
Wood	6.5	1.8	NA	NA	NA	0.7	6.7
Others	0.9	0.3	8.8	32.1	4.3	12.3	8.4
*NA, not available							

Source :Periathamby and Hamid (2009)

Table 4 presents the waste composition generated in Malaysia from year 1975 to 2005. The data shows that organic waste comprise the highest percentage followed by paper and plastics. This pattern is similar to data collected in this study where organic waste, paper and plastics are the three main waste composition collected.

Budhiarta, Siwar and Basri (2010) also show that organic waste is the major composition in Kuala Lumpur, Malaysia with 74% from total solid waste generation. Thitame, Pondhe and Meshram (2009) shows that 61% from solid waste generation in Sangamner City, India is organic waste. United Nation Development Programme (UNDP) (2008) shows that in Pulau Pinang, Malaysia, under administration of local council, Majlis Perbandaran Seberang Perai (MPSP) handling 63% organic waste from municipal solid waste collected under their authority area.

Organic wastes consist of mainly food waste and backyard waste. The production of organic waste is highest compared to others component because food is the essential needs for the people. Society tends to throw it out, rather than recycled it as compost, or used it for other usage.

Table 5: Comparison of Solid Waste Generation in Balakong area in 10 days intervals

No	Date	Type of Solid Waste (Kg/day)						
		Organic Waste	Paper	Plastic	Glass	Metal	Others	Total
1	23/1-1/2	4649.83	2975.11	1440.96	162.77	100.04	216.25	9544.95
2	2/2-11/2	5175.30	3303.12	1784.82	230.45	133.52	299.59	10926.8
3	12/2-21/2	5333.67	3034.92	2037.22	206.55	131.68	320.30	11064.34
	Total	15158.8	9313.145	5262.995	599.77	365.24	836.14	31536.09

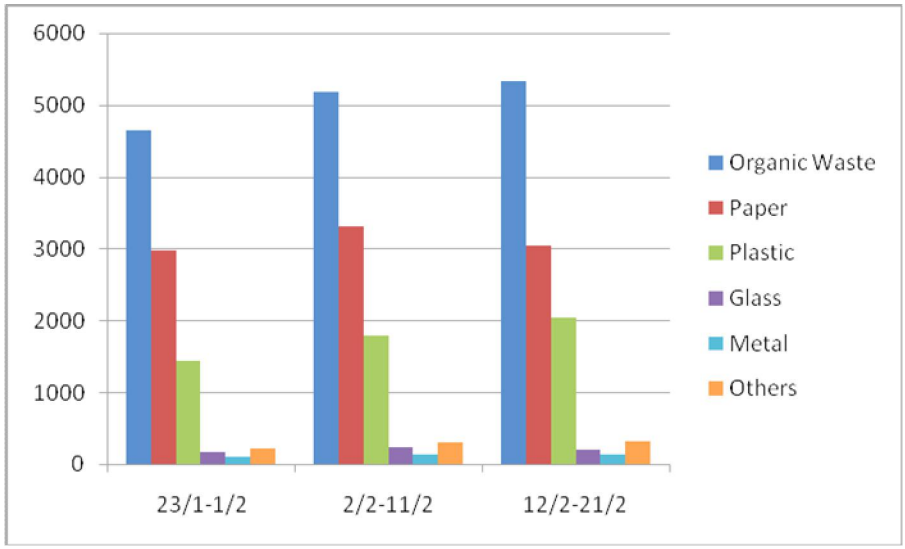


Figure 4: Solid Waste Generation (kg/day) in Balakong area for 10 days intervals.

It can be observed from Table 5 that, for the 10 days interval, the 3rd interval which is from 12th February 2012 to 21st February 2012 generate more solid waste compared to the other two intervals. From Figure 4, it shows clearly that in all the three intervals, organic waste is still the main component of solid waste composition generation. The 1st interval, which is between 23rd January 2012 to 1st February 2012 is the period where the generation of solid waste is less, compared to the 2nd and 3rd interval. This is mainly because on that period, Malaysia's were celebrating Chinese New Year. Balakong is considered as city area, therefore majority of the residents were going back to village and their hometown to celebrate it. Most of the factories in the industrial area also closed on that time. As the result, the amount of solid waste generated is less, since less people stayed in the city during that period.

High amount of organic waste produced in Balakong area need to be addressed carefully, and need to have a major concern regarding on the problem that may occur from it. Organic waste that sent to landfill rots under anaerobic condition, giving off methane gas, which is one of the greenhouse gases. This is supported by Torrento (2004) stated that organic waste in form of liquid manure can cause problems, such as bad odors, storage and transport difficulties, and water and air pollution. Daily MSW generation in Peninsular Malaysia in 2005 exceeds 19,000 tons. Agamuthu et al, (2006) in his report state that, about 75% of the wastescollectedare disposed of in 130 landfills and dumps, 20% of the organic waste is burned or dumpedinto rivers or at illegal sites, while 5% is recycled.According to United States Environmental Protection Agency (EPA) (2006), food waste that was included in organic waste is one of the potential dumpster issues such as odors, pests, and fires. Therefore, a proper and suitable solid waste management is essential to tackle issues that might rose from solid waste generation.

Plastic and paper composition was among the highest might be due to changes of the lifestyle which prefer to buy variety of ready-made foodstuff in packages and reading materials (Bolaane& Ali, 2004). While for metals which has the lowest composition, it is because metals usually been sold for the recycling purpose because of high price offered which is about RM2.5/kg compared to plastic and paper with the price RM0.45/kg and RM0.1/kg respectively (Budhiarta, 2012).

Conclusion

The results of solid waste composition generated in Balakong city indicate great variability between the waste compositions. Rapid economic growth, changes of the population lifestyle was found to contribute to this variability. In many developing countries like Malaysia, uncontrolled land disposal of Municipal Solid Waste (MSW) is common and can cause severe impact to human health and environment. Therefore, to enhance sustainable solid waste management in Malaysia, public awareness, funding, expertise, equipment and facilities that are currently lacking must be provided. Basically after completing of data Balakong, it plans to develop expert system to estimate the composition and growth revenue of municipal solid waste generated. Basically the implementation of expert system technology also is relatively new approach in solid waste management applications. Those applications enforce the belief that expert system can deal with solid waste management problems more efficient than conventional computer programs, if the capabilities of expert system are used wisely by the researchers and public user in term of management solid waste with effectively and successful management planning for the future.

References:

1. Agamuthu, P. and Fauziah, S.H. 2006. *MSW disposal in Malaysia: landfill management*. Published inProceedings of the 2nd Expert Meeting on Solid Waste Management in Asia and the Pacific Islands, Kitakyushu,November 23-24, 2006.
2. Budhiarta, I., Siwar, C. & Basri, H. 2012. Current Status of Municipal Solid Waste Generation in Malaysia. International Journal on Advanced Science Engineering Information Technology. Vol.2 (2012) No.2. ISSN: 2088-5334.
3. Badgie D., Mohd Armi A.S., Latifah A. M., Azizi M. 2012. Assessment of municipal solid waste composition in Malaysia: Management, practice and challenges. Polish Journal Environmental Studies. Vol. 21, No.3, pp: 539-547.
4. Law of Malaysia. 2007. Act 672, Solid Waste and Public Cleansing Management Act 2007. Malaysia: Government of Malaysia.
5. Thitame S.N., Pondhe, G.M., Meshram, D.C. 2009. Characterisation and composition of Municipal Solid Waste (MSW) generated in Sangamer City, District Ahmednagar, Maharashtra, India. Environ Monit Assess, 170, 1-5.
6. The Economic Planning Unit (EPU), Prime Minister's Department. 2006. *9th Malaysia Plan*. Putrajaya, Malaysia.

7. The Economic Planning Unit (EPU), Prime Minister's Department. 2010. Population by sex, ethnic group and age, Malaysia, 2010. Putrajaya, Malaysia.
8. Ministry of Housing and Local Government, Government of Malaysia, 2005. The study on national waste minimisation in Malaysia. Kuala Lumpur, Malaysia.
9. Malaysia's Deparment of Statistic. 2011. A map from Majlis PerbandaranKajang (Kajang Municipal Council) were given to this department, to get a population density on Balakong area, based on Blocks of Population and Housing Census of Malaysia 2000.
10. Majlis Perbandaran Kajang (MPKJ). 2011. Rancangan Tempatan MPKJ: Malaysia
11. Budhiarta, I., Siwar, C., Basri, H. 2010. Current Status of Municipal Solid Waste Generation in Malaysia. International Journal on Advanced Science Engineering Information Technology, 2, 16-21.
12. United Nation Development Programme, Malaysia. 2008. Malaysia Developing a Solid Waste Management: Model for Penang. Kuala Lumpur: Malaysia: Author
13. Torrento, M.S. 2004. Organic Waste in Spain: A Problem That Should Be a Resource. Paper presented at 11th International Conference of the FAO ESCORENA Network on Recycling of Agricultural, Municipal and Industrial Residues, Murcia, Spain.
14. United States Environmental Protection Agency (EPA). 2006. Putting Surplus Food to Good Use. Washington, DC: Author.
15. IPCC. 2006. Waste generation, composition and management data. Guidelines for national greenhouse gas inventories.
16. Periathamby, A.; Hamid, F.S. and Khidzir, K. 2009. "Evolution of solid waste management in Malaysia: impacts and implications of the solid waste bill, 2007," Journal of Mater Cycles Waste management, 11: 96-103.
17. Chen, C.C. 2005. An Evaluation of Optimal Application of Government Subsidies on Recycling of Recyclable Waste. Polish Journal of Environmental Studies, 14(2): 137-144.
18. Malaysia Statistical Board. Basic Population Characteristics by Administrative District. 2009. Annual Report. Malaysia.
19. Tarmudi, Z., Abdullah, M.L. and Tap, A.O.M. 2009. An Overview of Municipal Solid Wastes Generation in Malaysia. Jurnal Teknologi, 51(F) Dis: 1-15.
20. Zaini Sakawi. 2011. Municipal Solid Waste Management in Malaysia: Solution for Sustainable Waste Management. Journal of Applied Sciences in Environmental Sanitation, 6 (1): 29-38.

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