

SURVEY OF ILLEGAL DUMPING OF CONSTRUCTION WASTES IN MIRI URBAN CITY OF SARAWAK, MALAYSIA: PRACTICES AND EFFECTS ON ENVIRONMENT

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ABSTRACT

The growth in construction activities has led to the generation of large amount of construction wastes. This has effects on environment which constitutes a major problem in many areas which raises concern regarding safety, property value and quality of life in the community. This research was carried out in the city of Miri, Sarawak, to study the illegal dumping of construction wastes. The results obtained from the field survey indicated that a total of 29 illegal dumpsites were found. Most of these sites were vacant lands, road shoulders and road reserves. This study is essential in providing more information regarding illegal dumping of construction wastes, particularly Sarawak. Findings also showed that the illegal dumpsites of construction wastes require better coordination and enforcement of legislation in Sarawak. Other reasons that caused the illegal dumping of construction wastes are poor management, lack of construction wastes collection network and persistent illegal dumping, high cost of disposal, inadequate facilities and lack of awareness. It is recommended that improved construction waste management, frequent monitoring and practice of 3R (reduce, reuse and recycle) should be put in place to tackle the illegal dumping of construction wastes.

Keywords: *Construction waste, Illegal dumping, waste quantification, Composition*

1 INTRODUCTION

Over the past decades, construction industry in Malaysia was booming; however, the growth of construction activities has led to a notable increase in the generation of construction wastes. This is one of the contributions to the negative impacts on the environment, community and economy [1] and [2]. Construction waste generally refers to the waste generated from construction, demolition, renovation, real estate development, infrastructural development, earthworks and land clearing operations [3]. The wastes generated are bricks, concretes, steels, iron sheets, tiles, woods, plastics, cement bags, and so on. The large quantity of construction wastes generated has impacts on the environment, landfills and cost of disposal [4]. Even though there are landfills constructed for wastes disposal, but due to the large quantity of construction wastes generated; there are still many illegal construction waste dumpsites [5]. Illegal dumping refers to the disposal of large amount of solid wastes which is more than the volume of 0.12 m³ on any land area covered beyond 1 m² without any prior approval or permission from government authorities [6]. There is no much study done on the illegal dumping of construction wastes. The report on the solid wastes was not satisfactory causing insufficient and inconsistent data reported on solid wastes [7]. Solid wastes also include the

construction waste. From the study done by Chong and Nasir (2001) in Danish Cooperation for Environment and Development (DANCED), Sarawak Sustainable Urban Development Project and Natural Resources and Environment Board, it gave information on construction wastes generation in Malaysia.

Currently, illegal dumping of construction wastes has become more serious not only in Malaysia, but also all over the world. In many areas, illegal dumping is a major problem which raises concerns regarding safety, property value and quality of life in the community [1]. Due to the increase in the disposal fees of the landfills, illegal dumping is becoming a serious solid waste management problem [5]. This research is focused on survey, issues and challenges in construction waste management which encouraged illegal dumping in Miri, Sarawak. Currently, there is no data on illegal dumping of construction wastes in Miri, Sarawak. Information regarding current construction waste management was obtained from the Miri City Council which provides information on landfill sites in Miri. A survey on illegal dumping practices was to identify the locations of illegal dumpsites of construction wastes, the amount and composition of construction wastes dumped illegally. The outcomes from this research work would then provide useful information for improving the current problem of illegal dumping of construction wastes and for further research.

2 METHODOLOGY

2.1 Field Survey

The proposed field survey at the illegal dumpsites of construction wastes for this project is a heap survey. In heap survey, quantification estimate of the construction waste is based on the shape of the waste dumped. It can be divided into two forms which are scattered and stockpiled. This field survey was also used by Natural Resources and Environment Board Sarawak (2016) for the estimation of construction waste quantities at illegal dumping sites [8]. Each waste heap was considered as one sample and the information were recorded in a different form. The procedure in heap survey is as follows: [9].

- i. Estimate the total sample by observation at the site. This is to make sure all the construction wastes were included in the survey;
- ii. A form is prepared to record the data from the site investigation; and
- iii. Identify and quantify the composition of each materials of the construction waste on site.

2.2 Layout of Construction Waste at Illegal Dumpsites

The layout of construction wastes found at illegal dumpsites are scattered and stockpiled. For scattered wastes, it is assumed that the wastes are in the form of rectangular prism as shown in Figure 2 (a). The volume (V_s) was taken as the volume of the rectangular shape as in (1). While for stockpiled wastes, it is assumed that the wastes are in the form of rectangular base pyramidal shape as shown in Figure 2 (b). The volume (V_p) was taken as the volume of rectangular shape pyramidal shape, as in (2).

$$V_s = L \times B \times H \quad (1)$$

$$V_p = \frac{1}{3} \times L \times B \times H \quad (2)$$

Where; L, B, and H denote length, breadth and height of dumpsites respectively.

From the volume calculated, the weight fraction (W_f) of each composition waste materials was estimated by multiplying the percentage of specific waste fraction at site and specific weight fraction of each material as in (3).

$$W_f = P \times V \times D \quad (3)$$

P = percentage estimate of each construction waste (%)

V = total volume of the sample (m^3)

D = material density ($tonne/m^3$)

2.3 Zoning System for Field Survey

Miri City was divided into 6 zones to ease the field survey with Zone A, Zone B, Zone C, Zone D, Zone E, Zone F and Zone G. This zoning system is based on the Miri City Council (MCC) refuse collecting zoning system. Table 1 shows the sub-zones at each zone. Figure 1 shows a map of zoning system within Miri city area.

Table 1. Zones and Sub-Zones in Miri City, Malaysia

Zone	Sub-zone
A	Town areas (Includes Jalan Melayu to Jalan Krokop 1);
B	All primary and secondary schools; University / College / Hotels / Airport / Markets All Commercial Centre;
C	Jalan Miri By-pass, Kadang Kerbau, Riam, Taman Bumiko, Golden Hill Garden, Luak Bay;
D	Taman Tunku;
E	Krokop (Taman Yakin, Boulevard Garden, Taman Desa Seri, Jalan Krokop 1-10), Piasau (Piasau Jaya, Piasau Indah, Piasau Lorong 1-7, Shang Garden);
F	Piasau Lorong 8-12, Pujut area, Kuala Baram, Pulau Melayu, Lutong; and G Tudan, Senadin, Bandar Baru Permyjaya.

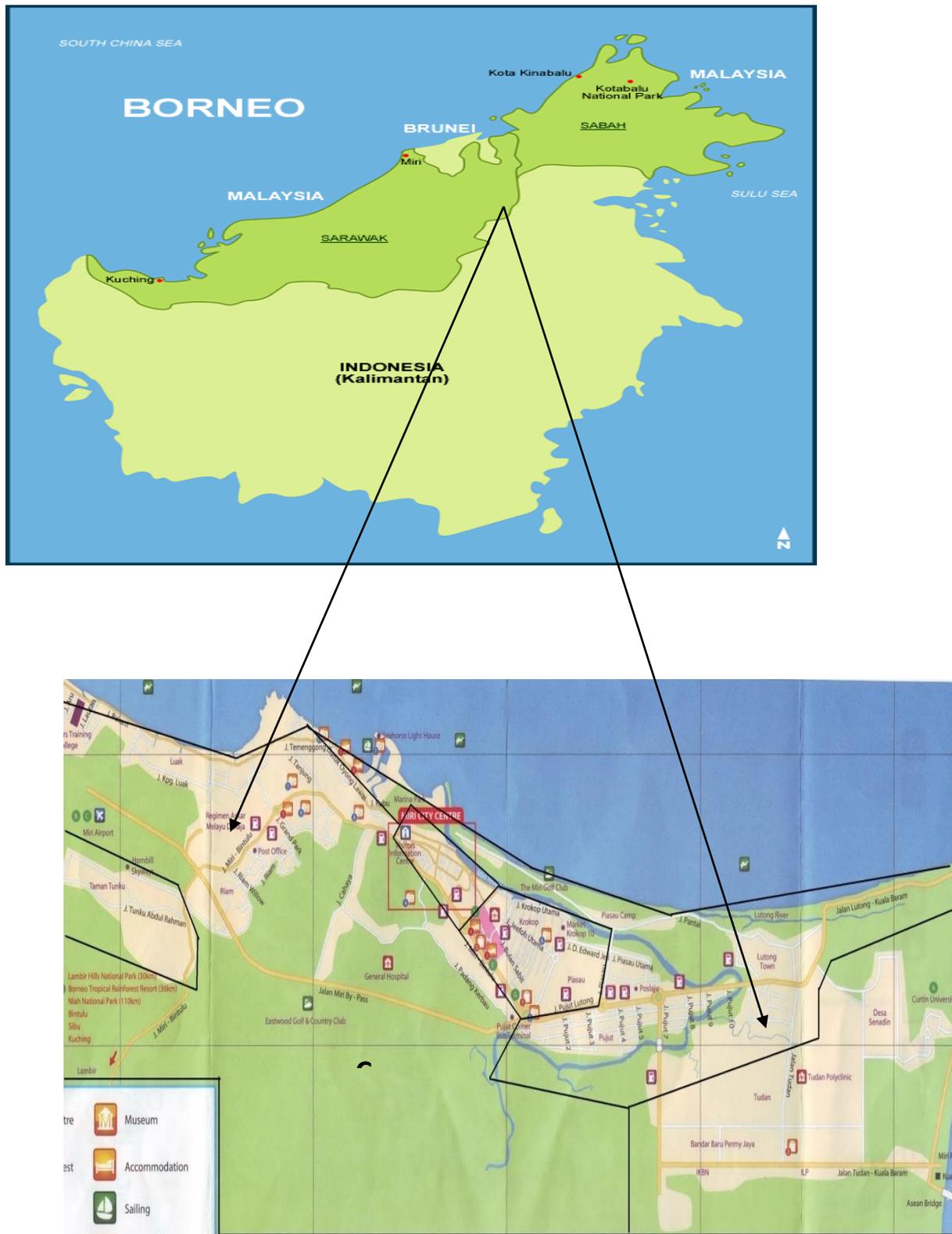


Figure 1. Map showing Zones in Miri City, Malaysia. Source [10]

2.4 Tools

The tools used in this field survey include: camera, digital weighing machine and measuring tape. A digital camera was used to take photos of the illegal dumpsites of construction wastes as the evidence of the presence of the illegal dumpsites. A digital weighing machine was also used at the construction waste samples on illegal dumpsites. Measuring tape was used to measure dimensions of the heap samples for the estimation of the quantity of construction waste generated at illegal dumpsites.



Figure 2. Scattered and Stockpiled Wastes

3 RESULTS AND DISCUSSIONS

3.1 Location

Many illegal dumpsites of construction wastes were identified throughout the study area. The conducted field survey located 29 illegal dumpsites of construction wastes within Miri City. Zone G had the highest dumpsites while Zone F had the lowest dumpsites. From the field survey, it is noticed that illegal dumping of construction wastes grows when people continue to dump solid wastes at undesigned areas. Unfortunately, this leads to the growing illegal dumpsites of construction wastes. The location of illegal dumpsites depends on the condition of the surrounding area, which types of activities involved, whether there are any construction activities or renovation. Through the field survey, it was found that the area with renovation or construction activities do have illegal dumpsites consisting of construction wastes coming from nearby. The location of these illegal dumpsites is shown in Figure 2.

3.2 Number of Illegal Dumpsites of Construction Wastes

From the field survey, it was found that there was a total of 29 illegal dumpsites of construction wastes in Miri, Sarawak. The number of illegal dumpsites of construction wastes at each zone is shown in Table 2.

Table 2. Number of Illegal Dumpsites of Construction Wastes in Miri City

Zones	Number of illegal construction wastes
A	0
B	0
C	8
D	5
E	5
F	3
G	9

From the field survey, Zone G had the highest number illegal dumpsites of construction wastes. There were 9 illegal dumpsites discovered in Zone G. Most of the areas in Zone G are residential. There is a only small portion of Desa Senadin being an industrial area. The large road reserve and vacant land in this area becomes the target of being illegal dumpsites. For example, Permy Technology Park, Tudan, is one of these industrial areas. The construction wastes from the nearby construction sites were dumped on the road reserve and vacant land. This is because it is near the construction sites.

There were 8 illegal dumpsites found in Zone C. The activities at the surrounding area of the sites are house renovation, industrial area and construction activities. The construction activities involved are residential and shop house construction. These construction activities led to the illegal dumping at that area. At Zone D and Zone E, 5 illegal dumpsites were found. The source of construction waste at illegal dumpsites comes from the renovation and construction activities near the area. From field survey, there are large spaces of vacant lands at Zone D and Zone E. The large spaces of vacant land become places of dumping construction waste illegally. Zone F has the lowest number of illegal dumpsites with only 3 illegal dumpsites. This is because there were no many construction activities there. Besides, the number of illegal dumpsites also depends on the distance of the construction sites to the dumpsites. The number of illegal dumpsites is higher near the construction sites or renovation activities site.

3.3 Characteristics of Illegal Dumpsites

Normally, road reserve is one of the choices for illegal dumpsites of construction waste. The reason is easy access to the site for dumping of the construction wastes. The idle road reserve for dumpsite is normally far away from crowded area. So that the illegal dumpsites of construction wastes at there would not be discovered easily. The vacant land is also very popular for illegal dumping of construction wastes. The reason is easy access and usually near to the construction site. From the field investigation, most of the vacant lands beside or near the construction sites have somehow become illegal dumpsites of construction wastes. The quantity of the construction wastes dumped at the vacant land is in large quantities. The size of the illegal dumpsite of construction wastes on road shoulders is small. The amount of the construction waste dumped is much smaller compared to others. Most of the illegal dumpsites at road shoulders were found at residential areas. The construction wastes dumped at these sites were from house demolition and renovation. Unfortunately the construction wastes dumped at the road shoulders were not removed by the contractors. Illegal dumpsites of construction wastes at the road shoulders affect the environment and property value of the area.

3.4 Composition and Quantities of Construction Wastes at Illegal Dumpsites

The composition and quantities of construction wastes were estimated during site investigation. Main components of construction waste found were: wood, concrete, brick, tiles or ceramics, soil and aggregates, hazardous waste, sand, steel and others. Table 3 below shows the amount of construction wastes dumped illegally at all zones.

Table 3. Summary of Construction Wastes Generation at Zones C, D, E, F and G

Zone	C	D	E	F	G
Waste Type	Weight (tonne)				
Wood	114.63	9.26	52.17	13.34	7.33
Concrete	114.51	55.20	24.00	6.07	48.85
Brick	63.36	68.13	12.50	1.39	114.64
Tiles/ Ceramics	0.40	2.37	8.69	0.20	16.71
Soil and Aggregates	96.19	31.68	7.20	2.88	16.71
Hazardous	0.07	1.95	0	0.20	1.20
Sand	0	2.88	2.88	30.24	1.12
Steel	0	3.76	0	0.10	3.55
Others	17.79	21.94	5.70	2.57	3.27
Total	406.95	197.17	113.14	56.99	196.99

The quantity of construction waste found at illegal dump sites ranged from 56.99 to 406.95 tonnes. As seen in Table 3 of summary of wastes generation at each zone above, Zone C has the largest amount of construction waste at illegal dump sites, which is 406.95 tonnes. Zone E has the lowest amount of construction waste, which is 56.99 tonnes.

Wood is the main material in construction which is used for timber formwork, false work, and scrap timber. Wood waste at all the illegal dumpsites ranged from 7.33 to 114.63 tonnes. It is the highest waste stream by measures of total weight found at Zone C and Zone E, which are 114.63 tonnes and 52.17 tonnes. The wide use of timber in the construction industry in Miri is due to the enormous timber resources in Sarawak. Among the illegal dumpsites found, the lowest wood waste generation is identified at Zone G, which is 7.33 tonnes. Concrete waste disposed on the illegal dumpsites at all zones ranged from 6.07 to 114.51 tonnes. Concrete waste does not make up any highest or lowest amount of construction waste in any zone. The quantity of concrete waste is highest at Zone C, which is 114.51 tonnes. The quantity of concrete waste dumped is similar to the wood waste amount in Zone C. Brick is one of the major components of construction waste which is used in wall partition. The amount of brick wastes ranged from 1.39 to 114.64 tonnes with the highest found at Zone G and the lowest was Zone F. The brick wastes found at illegal dumpsites usually is clay and concrete bricks. Tiles or ceramics ranged from 0.20 to 16.71 tonnes, soil and aggregates ranged from 2.88 to 96.19 tonnes, hazardous wastes ranged from 0 to 1.95 tonnes, sand and steel both ranged from 0 to 2.88 tonnes and others ranged from 2.57 to 21.94 tonnes. Hazardous materials such as asbestos (roof), fibre cement (ceiling) and gypsum sheet are expensive. So, hazardous materials were handled carefully to minimize wastage and increase in building cost. Scrap steel has high price in market. Due to the recyclability of steel, steel wastes were collected for resell purpose to earn extra income to cover the cost of construction works. The other wastes are mixed with wood, cement, bricks, steel, hazardous waste, soil and aggregates. Among all the zones, the largest composition of construction

wastes found is in Zone C (41.9%), followed by Zone D and Zone G both 20.3%, Zone E (11.6%) and Zone F (5.9%). This is shown in Figure 3.

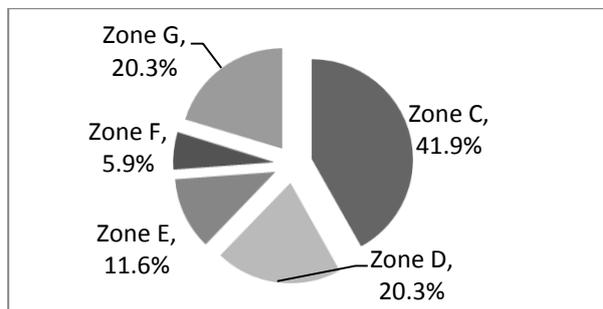


Figure 3. Pie Chart showing Composition of Construction Wastes Dumped illegally at all Zones

3.5 Issues and Challenges

In Sarawak, there is lack of description for the regulations [8]. Thus, a clear legislation on the disposal of construction wastes should be provided to encourage contractors or developers to consider waste minimization through the concept of reduce, recycle and reuse (3R) for zero wastes construction activities. There are various laws and regulations provided to control the negative impacts caused by the construction industry including the generation of pollution in other places. Unfortunately, only partial success was attained [2]. Common problems in enforcement are lack of authorization, lack of experienced and trained enforcement officers and insufficient manpower. This is because the local authorities do not have enough funds to support enforcement efforts on construction wastes disposal [2]. Enforcement officers should monitor the construction activities to make sure the construction wastes are disposed at designated landfills. Another issue of construction wastes disposal is inadequate facilities at landfills in Miri. The existing dumpsites at Miri, located at Kuala Baram and Sibuti do not have adequate facilities for the recycling purpose and any sorting of the construction wastes disposed. The Kuala Baram dumpsite has limited space for landfill, which is only 7.5 hectares of operated area. There is no proper dumpsite for construction wastes. It is a common practice for the contractors or developers to arrange their own transportation for construction wastes disposal to dumpsites. The nearest landfill operated by Miri City Council is at Kuala Baram. The landfill site covers the area of 7.5 hectares. The size of the landfill at Kuala Baram is smaller compared to the one at Bekenu. The Bekenu landfill has the area of 110 hectares and it is operated by Bekenu District Council. Bekenu landfills are further away from Miri city. Therefore, contractors or developers choose to dispose their construction wastes at Kuala Baram landfills. However, it is not sufficient for the construction wastes. The characteristics of illegal dumping of construction wastes are related to the location of persistent illegal dumping. The common areas for illegal dumpsites were identified to be on vacant lands, road shoulders and road reserves. Through field investigation, vacant lands were found to be the most preferable places for illegal construction wastes disposal. The transportation cost is included as part of the construction cost. This may prompt the contractors or developers to find alternate way to dispose the construction wastes. Thus, illegal dumping becomes an easy way and cost saving for some contractors or developers.

Parties that are involved in construction sector are developers, contractors, consultants, local authorities and communities. During the field study, it was spotted that the parties involved especially contractor or developer had no awareness of effects of the construction waste. Miri City Council, Natural Resources and Environment Board and Department of Environment focused on the solid

municipal wastes compared to the construction wastes. This caused the illegal dumping of construction wastes go unchecked. Besides, attitudes of local communities regarding illegal dumping of construction wastes are not encouraging basic sanitation in the city. Local communities do not care of illegal dumping of construction wastes. Lack of care by the local communities partly caused the illegal dumping of construction wastes unchecked. This prompts the contractors or developers to dump their waste illegally.

4 CONCLUSIONS

In conclusion, this study has useful information regarding illegal dumping of construction wastes. The illegal dumping of construction wastes in Miri city is not at an alarming stage now. However, local authorities, parties involved in construction industry and the local communities have to pay more attention on this issue as it may get worse if there is no further action plan taken. Good construction wastes management should be practiced by contractors and developers to prevent excessive construction wastes generation. The contractors or developers should be aware and practice the appropriate construction method to reduce wastes generation during construction. From the findings of the illegal dumpsites of construction waste, it reflects the poor management of construction wastes. The contractors or developers do not have appropriate management strategies for construction wastes disposal. Construction Industry and Development Board (CIDB) do not have training programs and seminars regarding construction waste management. Parties involved in construction industry should undergo training regarding sustainability building and wastes management. Enforcement and frequent monitoring at construction sites or illegal dumpsites of construction wastes by local authorities and government agencies is recommended. The purpose of frequent monitoring at construction sites is to make sure the construction wastes are managed in a planned and appropriate way. Frequent monitoring at illegal dumpsites of construction waste is to put off the practice of dumping the construction wastes illegally. The recycling program should be commercially promoted by private agencies and local authorities. The recyclable waste materials should be categorized to make the collection easier and systematic according to the material types. Recycling can reduce the impacts on the environment and illegal dumping problem. For example, concrete can be crushed into smaller sizes and used as secondary aggregates in concrete mixing or any other structural layer for landfills.

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