CHAPTER THREE: METHODOLOGY

3.1 Background information of the study areas

The study areas are situated in South West of Federal Territory, Kuala Lumpur (refer to Map 1.1). Taman Bukit Angkasa settlement and surrounding areas has a population of 9,230 people. The population grow in two main ways: by migration, i.e. people from non-urban areas coming to take up permanent residence in city; and by natural increase, i.e. the excess of births over death of the residence.

The Long house settlement has a population of 1,030 peoples. Around 400 people are living in the squatter settlement. The squatter settlement is a non-conventional housing which does not comply with the accepted procedures and often does not conform to the legislation. The housing is often a collection of primitive shacks made from any material available- wood, corrugated iron and cardboard. Most houses lack basic amenities as clean running water, toilets and inadequate municipal solid waste collection points. Individuals growing up in this culture is likely to be fatalistic, and feel helpless and inferior. These characteristics, together with the proverty of the family or individual, led to a totally negative view and their role in solid waste management. The Pantai Dalam area is a fast growing township and is gearing towards development and going through a high rate of urbanization. The geographical layout of the settlements are presented in Map 1.2.

In recent years, the production of municipal solid waste in Taman Bukit Angkasa, long houses and in squatter areas grew considerably both in absolute and per capita terms. Due to mushrooming of high-rise buildings, which are associated with high population density and standard of living, the amount of the solid waste generation had increased. Stall owners didn't adopt proper waste management methods to protect the quality of life and kept the environment free of pollution.

3.2 Method

3.2.1. Field survey

One useful way to approach the research process is to identify the basic dilemma that prompts the research and then develop questions by progressively breaking down the original question into more specific ones The first stage in this study was done by conducting a public survey and meeting with a wide range of residents. The public survey includes; door-to- door survey using questionnaire(250 samples). The second stage was done by conducting a general observation and interview with public. The samples for these two surveys were selected randomly by systematic sampling method. Table 3.1 is a summary of the two surveys. Figure 3.2 models the sequence of the research process.

Table 3.1. Summary of the surveys

Target group (survey)	Form of survey (sample size)	Data/information collected
General	observation and interview	public awareness of municipal solid waste management(MSW)
Household	door-to-door survey	waste generation, household solid waste management and public awareness of MSW

The survey was done to discover views and opinions of the people, since they impose the largest effect on the solid waste management(generation, composition and management) and to explore the human attitude towards solid waste management. The methodology, sampling plans and sample sizes were adopted from Chung and Poon (1994). A sample of the questionnaire is given in Appendix 1. A significance level of $P<0.05$ was accepted as significant. This means that the particular results has only a 5% chance of occurring through random variations. The quantification and other parameters (heavy metals, water extractable nutrients, nitrogen, pH, acidity, alkalinity, conductivity) was determined by using standard methods(Flame Spectroscopy, Kjeldahl Auto Analyser, Radiometer Electrical Conductivity measuring Instrument, pH meter model).

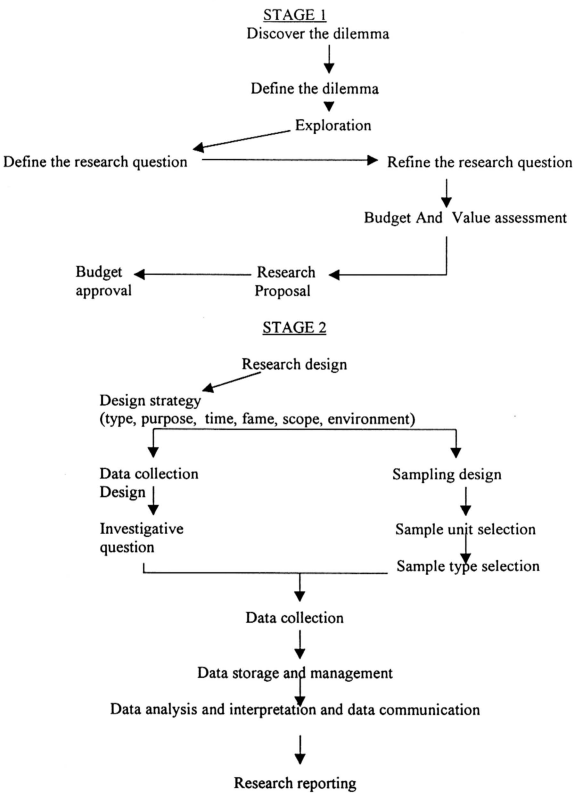

Figure 3.2: Models the sequence of the research process

3.2.2 Density

In order to determine weight, density and solid waste composition, a random sampling procedure was used which ensured the municipal solid waste had equal chance of being included in the sample. Three samples were taken from each sampling point : A, B, C (refer to Map 1.2 in page 12). The samples were kept in open air so that the concentration of the solid waste to be analysed were unchanged during transportation and possible storage. The samples which cannot be analysed immediately were stored in refrigerator. After a absolute mixing, the municipal solid waste density was established as follows: waste was filled into a metal bin of known volume and the bin was shaken to ensure that the volume was totally occupied. The bin was weighed before and after filling the weight of the refuse thus obtained. The density of the waste was then calculated by dividing the weight by the volume of the sample. Finally, the refuse was manually sorted and each component was weighed separately and recorded.

3.3 Waste composition determination

3.3.1. Nitrogen Test

Kjeldahl Nitrogen is the sum of ammonium -N and organic nitrogen compound, which can be converted to ammonium-N under Kjeldahl reaction conditions. The portion of organic nitrogen may be obtained by subtracting the ammonium content from the Kjeldahl nitrogen value. A 0.05 mg of waste sample was placed in the Kjeldahl flask and treated with 1g of reaction mixture (5g selenium, 5g copper sulphate, and 250g-sodium sulphate mixture) and 10ml of ethanol. After shaking, 10ml of concentrated

sulphuric acid was added and the mixture heated to boiling until a light colour was obtained and solid particles are no longer visible. Boiling was then continued for another 30 minutes. This process removed nitrite and nitrate. After cooling and diluting with water to a total value of 300ml, the content was transferred to the 1L flask after rinsing the Kjeldahl flask twice. A few drops of phenolphthalein solution were then added together with sufficient sodium hydroxide to change the colour of the content red.

The flask was then attached to the distillation apparatus and 200ml distilled over, during which the end of the condenser was dipped into the absorber. The ammonium-N content was then determined titrimetrically or photometrically depending on the original nitrogen content. The photometric method was preferred for a nitrogen content of less than 100mg/l, whereas the titrimetric method is employed at higher concentrations. The distillate was collected in a 250ml volumetric flask containing 50ml water; 100ml of this solution was mixed with 3 drops of the mixed indicator solution and the titration carried out with 0.025ml sulphuric acid until the colour change from violet to green is observed. Two blank samples were prepared using 20mg catalyst and 10 ml H_2SO_4 . Note: need to use distilled H_2O to wash auto analyzer pipeline until reading is stable ~ near 0. Standard acid used 0.2 M HCl

Titrimetric determination:

Kjeldahl N(m/gL)=a.b.700mg /c.d mL

a = consumption of 0.025 M H_2SO_4 (mL)

b = aliquot of distillate taken (mL)

c = sample volume (mL)

d = total volume of distillate (mL)

Calculations

$$\%\ of\ nitrogen = \frac{(T-B) \times N \times 14.0\% \times 100}{\text{Wt of the sample in mg (0.05 mg)}}$$

Where

T: titration volume for sample

B: titration volume for blank

N: normality for acid.

Blank preparation

1. *20 mg catalyst*
2. *10 mL $H_2 So_4$*
   prepard in 2 tubes

3.3.2. Determination of pH, acidity and alkalinity

10 grams of the waste sample was placed in a flask, and 500 ml distilled water was added and stirred for 3.5 minutes. The mixture was allowed to settle for 5 minutes and the pH was measured using pH meter (Pye model 290) with a glass electrode previously calibrated and corrected for temperature.

3.3.3. Conductivity

To determine the total inorganic salt in a sample, an electrode Radiometer conductivity instrument was used. A low-voltage alternating current was applied across the electrodes. The resistance of the liquid between the electrodes was measured, which was then converted into conductivity according to the equation

$$K = L / AR$$

Where

K = conductivity;

L = distance between electrodes (cm);

A = surface area of electrodes (cm^2);

R = resistance (siemens, S).

The units of conductivity applicable to environmental samples are $\mu S\ cm^{-1}$. The cell was calibrated using solutions of known conductivity. Conductivity is highly temperature

dependent and so care was taken that calibration solutions and the unknown sample are at the same temperature.

3.3.4 Moisture

In order to determine the moisture content, the entire crude sample was weighed and spread thinly and dried over oven till its mass becomes constant. Drying was done at 105^0C but in case of combustibles the temperature was 70 to 75^0C. The samples were weighted immediately after cooling under controlled conditions for microbiology testing.

Calculation

DS + W = 100 (NS)
c = a - b
e = d - b

$$W = \frac{e - c}{c} \times 100$$

DS = (e/c) x 100

Where

DS = dry substance of the crude sample, percent by mass;
W = moisture content of the crude sample, percent by mass;
NS = non-dried substance of the crude sample;
c = net mass, wet;
a = gross mass, wet;
b = mass of receptacles (tare)
d = gross mass, dried and
e = net mass, dried

Replicates

Each samples was analyzed at least twice. The standard deviation of the mean value was less than 10%. In cases where the standard deviation was higher than 10% , the number of analyses was increased to get better accuracy.

3.3.5 Determination of water extractable elements in municipal waste

The concentration of elements in solid waste samples was determined as follows. The main elements NH^{4+},NO^{3-}, P, K, Mg, Ca, Al, Fe, Cl^{-} and S were analysed by X-ray fluorescence spectrometry. This technique was based on the irradiation of an atom with

X-rays leading to the ejection of an electron from an inner shell. Outer shell electrons cascade to the inner shell to fill the vacancy, emitting x-rays. The wavelength of this radiation is related to the atomic number of the nucleus according to the equation

$1/\lambda = kZ$ where

λ = wavelength of radiation;

k = constant;

Z = atomic number;

i.e. elements emit radiation at characteristic wavelengths. Absorption and emission occur predominantly in first few surface layers of atoms. With suitable corrections for matrix effects, which may include the preparation of standards with composition as close as possible to the sample, the intensity is proportional to the concentration of the element.

3.3.6. Other determinations

The Hardness, Chloride, and Sulfate were determined using Hanna Instruments HI4817 test kit.

3.3.7. Heavy metals determinations by Flame Spectroscopy (Flame Photometry)

Heavy metals in the municipal waste (e.g: Pb, Cd, Cr, Cu, Ni, Zn, Hg etc) were determined using Flame Spectroscopy. Each samples were analysed at least twice.

3.3.8. Microbiological testing

Testing of several microbiological parameters.

(1) Viable count: the regular assessment of microbial numbers per unit weight of samples.

(2) Identification was done by using two methodology;

(i) initial classical microbiological identification techniques such as colony morphology, Gram stain, Spore stain, Motility testing (Sloppy Agar), and

(ii) modern methodology –API And Enterotube methods.