A nature and sources of data

Methodology

Nature and sources of data

The specific data required for this study were from primary and secondary sources. Secondary data were obtained from the Ibadan North Local Government Authority and Ibadan Waste Management Board. Analogue map of the study area was obtained from the Local Government headquarters. Land use map (1995), road map, elevation data, rail line data were made available from Ibadan Waste Management Board. A field visit was paid in order to determine the names of features on the analogue map in the attribute field of the digitised copy. GPS was used to capture points on ground for analysis.

Hardware and Software

The hardware used in this study included PC Pentium IV (RAM 250 MB, HD 2 GB), HP DeskJet 1220C color printer, HP Scanjet 2400, Logic Trace digitiser, Sony digital camera (8mp) and Garmin E trex 12 channels GPS receiver. The software used in preparing and analysis of the data included MS Excel, ArcView 3. 3 with Network Analyst and Super decision for the AHP aspect.

Digitising

The base map was transformed into digital map for use in GIS by digitising using the platform of ArcView 3. 3 GIS software. Digitising a map means converting an analogue map into a digital form by encoding the spatial coordinates of features on the map through the process of on-screen digitising. A digital map that is recognised by the computer in a GIS environment is the end-product of this exercise.

Data analysis

Five major GIS spatial operations were performed to achieve the set of objective for this project. These are, buffering, overlay, query, network analysis and nearest neighbourhood analysis

Buffering

It is a spatial analysis known as proximity analysis, generating zones of a given distance around a feature theme. It forms a polygon around a point, line or polygon theme by locating its boundaries at a specified distance. GIS can create buffer zones around selected features. The roads and rails were buffered at a radius of 100m (Javaheri 2006) while the streets were buffered at a radius of 30m.

Overlay

Overlay was performed to identify areas that meet all the set criteria and to show areas that do not meet the criteria. GIS can overlay different pieces of information. It helps in understanding the association between network analysis and specific geographic features. Ibadan North map and other data were overlaid to get possible sites.

Query

This command is used to answer the question of ‘ what is and where is’ in GIS. The land use was queried to get the open space while the elevation was queried to get the suitable elevation.

Network analysis

Arc view Network Analyst is a powerful extension that provides network-based spatial analysis including routing, travel directions, closest facility, etc.

This was made use of in this study to show the possible routes of connection from the transfer stations to the disposal site.

Nearest Neighbour Analysis

The nearest neighbour analysis helps to determine the nature of the distribution of the features which can be clustered or scattered. It is employed in this study to determine the pattern of skip distribution. If the index is less than 1, the pattern exhibits clustering and if greater than 1, the trend is toward dispersion.

Cartographic model

‘ The cartographic model is simply a graphical representation of data and procedures’ used in a study (Eastman 1995). It is a set of interacting ordered map operations that act on raw data as well as derive intermediate data to simulate a spatial decision making process (Tomlin, 1990). It shows all the layers of information starting with the base maps on the left and ending with the end product on the right. Its purposes are to help the analyst organise and structure the procedures that the analysis to be performed in a study will require and to identify the data needed to complete them.

LU= Land-use

The above cartographic model was constructed based on the following parameters:

The land use maps was queried because site location must fall outside the land use areas so that settlement will not be polluted by the exhume/stench from the waste.

The roads and rail were buffered at a distance of 100m and the streets were buffered at a distance of 30meters to create a good distance between them and the landfill site.

The elevation was queried to get an elevation greater than or equal to 222meters so that it will not be located in an area that is too low because of water flow.

Questionnaire

Questionnaires were designed to seek public opinion as they include part of decision-making in a study such as this. 720 questionnaires were distributed among the various stakeholders, which include the public, planners and officials of Ibadan Municipal Government and Waste Management Board. In order to identify the criteria for siting, opinions from planners were required. Questionnaires were given out to 10 experts as part of public participation. Questionnaires were also distributed among the people living in the major areas where skips were to be allocated. These areas include, Oje market, Gbenla, Adeoyo, Danadaru, Premier Hotel, Jemebewon, Poly road, Cultural Centre, Bodija, Ikolaba, Oyo Secretariat. 60% of the questionnaires were distributed around the southern part as it was observed during field visit that most illegal dumpsites are around that area.

Criteria for selection

To arrive at the selection criteria for choosing a site for landfill, relevant literature and decision makers' opinion were sought.

- Site must be close to at least a street with a buffer of 30m (Decision makers' preference)

- Site must not be too far from a transfer station (Decision makers' preference)
- Site must be 3km from residential areas, with the exception of areas with barriers (trees, hills, etc.) (Banar et al. 2007).
- There should be a minimum distance of 100m between site and roads (Decision makers' preference, Javaheri et al. 2006)
- Site must be on a suitable soil.
- Site should be constructed in areas which do not have an important economic or ecological value (Lober 1995, Siddiqui et al. 1996).

The AHP component

Finally, in the second step, a decision hierarchical structure using the AHP was developed and implemented to rank the two suitable sites according to their suitability for landfill siting. The AHP can assist in identifying and weighting selection of criteria and expediting the process of decision making (Sener 2010). Preferences of decision makers can be included in a planning problem within an AHP. The problems then structured in a hierarchical form to allow for weighting of the preferences by pairwise comparisons (Phua and Minowa 2005). The AHP typically involves establishing a graphical representation of problem as a hierarchy, weighting the elements at each level of the hierarchy and calculating the weights (Phua and Minowa 2005). The AHP methodology compares criteria or alternatives with respect to a criterion, in a natural, pairwise mode. To achieve this, the AHP uses a fundamental scale of absolute numbers (Table 3. 2) that has been tested in practice and validated by physical and decision problem experiments. It is perhaps the most widely used decision making approach today. The AHP is generally used to support other methodologies such as in deciding how

many servers to employ in a queuing situation taking into account factors like costs, waiting times and human frustration. Several other applications include resource allocation, forecasting, etc.

The Super Decisions software (Saaty 2003) was used in developing the AHP model. A Super Decisions model generally comprises clusters of elements rather than elements arranged in levels. Clusters contain node which represent the elements in them. For example, the criteria for siting a landfill may include proximity to transportation networks, proximity to waste collection centres, etc. These represent the nodes in the ‘ Criteria’ cluster. When a line joins a cluster with another cluster, it means the nodes in both clusters are connected together. The main aim of using the AHP is to assign weights to criteria and come out with the best alternative.