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Analysis and Management of Waste Disposal in Jalingo Metropolis Taraba State Nigeria

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ABSTRACT

Mankind must inevitably generate wastes of various forms regardless of the social and economic stature. A waste is unwanted or unusable materials. Solid waste disposal in cities has become a major environmental problem to which Jalingo metropolis is not an exception. These problems include degradation to the physical environment and environmental health hazard such as disease transmission, offensive odors, pollution etc.The use of remote sensing and GIS techniques for site suitability study cannot be over emphasized, the technique brings real, authentic and highly technological and scientific results. The system combines data, mapping and image processing and statistical analysis in a single frame work. The study used GIS integrated standard methodology for the selection of site, which are suitable for the disposal of waste in the study area. A number of environmental factors such as major drainage buffer zones, settlement and economic factors like road network as well as physical factors like topography were incorporated in the modeling of the suitability site for waste disposal. From the result of the analysis, it was observed that the areas that are "unsuitable" for waste disposal were found around the central business district. The extreme north west of the study area and few parts of south east were found to be suitable for waste disposal. It was revealed from the study that almost all the existing waste disposal sites are found in unsuitable areas which put the health situation of the inhabitants at risk.This approach is easy to understand and it can illustrate which areas are unsuitable, and suitable for waste disposal sites. The criteria used in this study are not fixed since it can vary from area to area.

Keywords: Waste Disposal, Management, Unsuitable, Environment, Inhabitant

I. INTRODUCTION

It is a settled law of nature that biological organization must essentially generate waste. It follows therefore that regardless of the social and economic stature, mankind must inevitably generate wastes of various forms (Ugwanwa, 2005).

A waste is unwanted or unusable materials. It is a substance discarded after primary use, or is worthless, defective and no use. A by-product, by contrast is a joint product of relatively minor economic value (Doron et al 2018).

According to Ugwanwa (2005), urban solid waste management is considered as one of the immediate and serious environmental problems confronting municipal authority in many cities in developing countries. The rapid growth of population and urbanization increases the non-renewable resource and disposal of effluent and toxic waste indiscriminately are some of the major environmental issues posing threats to the existence of mankind. The most common problems associated with improper management of solid waste include disease transmission, fire hazards, and odor nuisance, Atmospheric and water pollution, aesthetic nuisance, and economic losses. Waste disposal is an important part of waste management system, which requires attention to avoid environmental pollution.

Jalingo is lacking available facilities for waste management. Wastes are usually carried out

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by traditional method that is throwing it at all types of vacant land in and around the city. Many solid wastes are seen on streets, open land and in drainage system. This can be carried and littered during heavy down pour during the rainy season (Henstock, 1983). This occur as a result of problems such as inadequate dumping sites, inaccessibility to some collection centers due to improved or narrow streets, lack of precise guidelines and laws related to waste disposal. Clarke (1992) asserted that, people discard waste on the streets, drainage systems and gutters without knowing the danger they cause to the environment and health

Solid waste disposal in cities has become a major environmental problem to which Jalingo metropolis is not an exception. These problems includes degradation to the physical environment and environmental health hazard such as disease transmission, offensive odors, pollution etc., in accessibility to some of these dump sites for the evacuation of solid waste as well as lack of existing and up to date map of existing dump sites within Jalingo metropolis

It appears there does not exist in the state a clear policy on the mode of solid waste disposal despiteincreasing human population and activities thus putting pressures on our environment with adverse effects. Could it be that stakeholders are finding it extremely difficult to manage municipal solid waste or that all level of society has underestimated the significance of proper municipal solid waste management? This study is aimed at identifying suitable waste disposal site(s) in Jalingo with a view to relocating existing dump sites which are unsuitable with a view to map the existing dump sites in the area and to identify and analyze criteria for dump site selection and to use multi-criteria evaluation to determine suitable site for refuse disposal

Huge amount of waste are being generated from homes, institutions and commercial areas in Jalingo and mostly disposal of such waste are random at different location and where it is compacted in a place it will be treated thermally. Therefore site selection analysis can be improved by using GIS. Geographic Information System (GIS) can provide an opportunity to integrate field parameters with population and other relevant data

Rhaji (1998) concluded that, traditional knowledge and skills are also applied in managing domestic and other waste generated. For example liquid wastes are used in irrigating the gardens while solid waste matter are decomposed and used as manure in the farm. In Mubi metropolis selection of disposal site is located without considering residential areas, clinics/hospitals, educational institutions, drainage network, socio-cultural and religious institutions but this is not as observed by Monoliadis (2002) that a suitable disposal site must have environmentally safety criteria's and attributes that will enable the waste to be isolated so that there is no inacceptable risk to the people or environment while it is operating. Therefore criteria for site selection include natural physical characteristics as well as socio economic, ecological and land use factors.

1.1 Study Area

The study area [Jalingo] is covered by latitude 08° 43´N and 09° 07´N of the equator and longitude 10° 50´E and 11° 25´E of the Greenwich meridian, covering an approximate land mass of 59,400 square kilometers. The study area is bounded by three local governments, Lau to the North, Yorro to the East and Ardo-Kola to the south

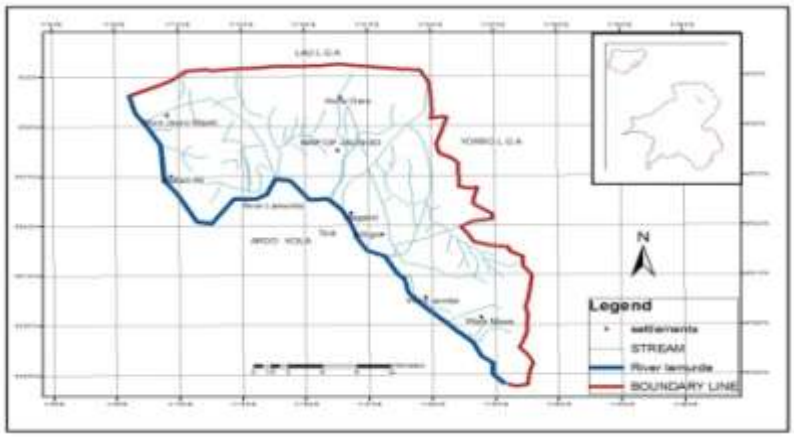

Figure 1: The Study Area

Source: Ministry of Land and Survey

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Depending on the availability of software, hardware, level of sophistication and knowledge, time-frame as well as the objectives of any research, the use of Remote Sensing/GIS techniques for suitability studies varies in their approaches and methodologies. For the purpose of this research work, simple and relatively available software packages and hardware materials for Remote Sensing/GIS techniques was used to generate precise and reliable waste sites through the acquisition of the relevant data for identification of suitable sites for waste disposal in Jalingo as well as the digital mapping and analysis of the data with Remote Sensing/GIS techniques.

II. MATERIALS AND METHODOLOGY

Hp 625computer was the main computer hardware used, while the GISsoftware packages that were used for the research are ILWIS3.7A andIDRISI Taiga. ILWIS 3.7A was used for geo-referencing of the map. The map was digitized using ARCVIEW 3.2A, while IDRISI Taiga was used for all the analysis such as overlay, re-class, buffer, and area calculation. Other supporting non GIS package includes coreldraw-12 through which the map was scanned and exported to ILWIS for geo-referencing.

A topographic map of Jalingo was acquired from the Ministry of Land and survey, Jalingo, Taraba state to delineate the boundary of the study area. A Quick bird image of Jalingo 2014 was purchased and used for analysis while SRTM of Jalingo was used to generate the drainage network and elevation map of the study area

2.1 Methods

A Garmin 72 GPS was used to capture the coordinates of the existing dump sites in Jalingo which was linked to the Jalingo map for suitability analysis of the existing waste site (the topographic map wasresembled using two software packages i.e. ILWIS and ARCVIEW)

The map of Jalingo was scanned as Tagged Image File Format (TIFF) using Corel draw- 12 and imported to ILWIS environment and geo-referenced. Geo-referencing ensures that coordinates of pixels in the image corresponds to the true coordinates of the points they depict on the ground without which the maps will not overlay. The map was geo-referenced using the values of the LATLON (Latitude and Longitude) coordinates. The coordinate was converted to UTM(Universal Transverse Mercator) zone 33 N, through the coordinate transformation module of the ILWIS software. The map was geo-referenced by selecting the four corners on the maps as tie points. The transformation gave the minimum "X" and "Y" values and the maximum "X" and "Y" respectively

The four criteria considered in this work were:

(a) The Waste Site must be at least 3km away from Residential Land-use:

Areas that are within 3km of the currently developed land are considered unsuitable. This is because of the public health hazards that can easily affect the inhabitants, if the sites are near to settlement areas.

(b) The Waste Site must be at least 1km from major Water Bodies: If the value of the environment is put into consideration, waste sites are not expected to be sited in areas that are less than 100m away from water bodies in order to avoid possible contamination from the waste by the water bodies.

(c) The Waste Site must be 300m away from Major Roads:

Logically, environmentalists prefer only areas within 300m of roads as suitable waste sites for easy accessibility and disposal.

(d) The Waste Site must be between l00m and 600m height. This means that the elevation of the site must be greater than 100m but not greater than 600m, because areas below l00m and above 600m may be considered unsuitable, due to low and high elevation respectively(Oyinloye,2015).

All this criteria was overlaid using IDRISI Taiga so as to generate a suitable map of waste in Jalingo.

2.2 Data Preparation for Spatial Analysis.

Thematic maps for each of the stated criteria which include residential land use (built-up areas), drainage map, and road network map and the relief map of the study area. Each of the set criteria for suitability was composed as follows:

a. The residential land use area was isolated from the land use map of Jalingo.

The isolated map was buffered through the buffer module of ArcGIS software at 3Km away from the residential land-use. Areas within the 3Km buffer zone were classified as unsuitable and other areas as suitable.

River Lamurde and some few other ones were buffered to give areas within 1000m (1Km) along the rivers as unsuitable and areas that are at least 1000m away from the rivers as suitable.

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The road map was also buffered, to give suitable and unsuitable areas. Areas that are within 300m along the road are being classified as Unsuitable because of accessibility, while areas that are more than 300m away from the main road are considered suitable.

The relief map of Jalingo was extracted from digital elevation model of Nigeria. All the areas above 100m and not more than 600m were isolated and considered as suitable while areas less than 100m and higher than 600m were considered unsuitable.

2.4 Mapping the Suitable Area

On the suitability map, all areas with value "4" were considered "suitable", areas with values "3, 2 and 1" were considered "unsuitable", for waste disposal.

2.5 Suitability Verification of the Existing Dump Sites in Jalingo

GPS coordinatesfor some of the existing dump sites in Jalingo were collected and database was created. The coordinate of the waste site was then link with the suitability map to produce suitability verification map.It was revealed that the sampled existing waste sites in Jalingo were all located in unsuitable site.

III. PRESENTATION AND ANALYSIS OF RESULT

3.1 Buffer Analysis

The buffered built-up area map show that part of the North West, North East and South Eastern are suitable while more than three-quarter of the study area are unsuitable. The buffered river map shows that about three-quarter of the study area is suitable while the buffered portion of river Mayogwoi which flows North East direction into Lamurde are considered as unsuitable. The buffered 300m away from major roads network which extends from North West to South Eastern was considered as unsuitable while over half of the study area that is North West, North Central, part of North East and South Eastern are suitable for waste disposal. The buffered relief map criteria put the whole of the study area suitable for waste disposal site.

3.2 Map Algebra

The River-Settlement map was reclassified into two classes1-suitable 2-unsuitable.The result of the re classification show that patches of the extreme North West, North East and South eastern are suitable site for waste disposal while the bulk of North West, North central, South West and South East which constitutes more than 75% of the study area is unsuitable. The Road-Relief map was reclassified and the result show that most part of the North West, North Central, North East and patches of the South East are suitable for waste disposal while the major road network which extends from North Central to South Eastern and patches of North East are unsuitable for waste disposal.

Finally the overlay operation of River-Settlement map and Road-Relief map produced suitability map. Areas with value of 4 were considered suitable, areas with values 3, 2 and 1 were considered unsuitable. The result which show that most part of North West, North Central, North East are unsuitable while extreme part of North West, South Eastern and part of North East are suitable as in Figure 5.

The linkage of coordinate of the existing waste site and suitability map revealed that the sampled existing waste sites in Jalingo were all located in unsuitable areas. The result of this study revealed that the health of all the inhabitant of Jalingo are in danger as they are all prone to diseases as postulated by Clarke, (1992).

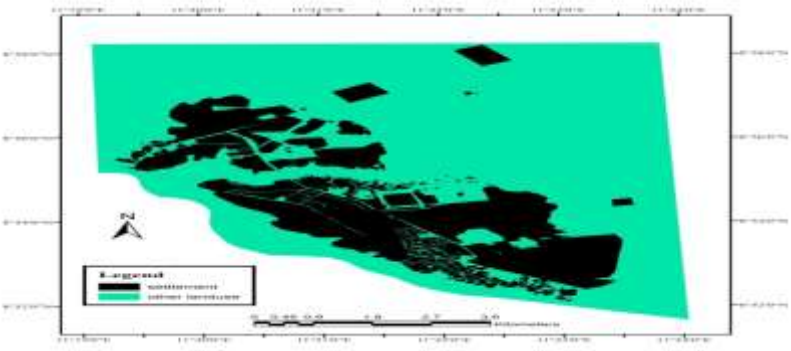

Figure 2: Settlement map.

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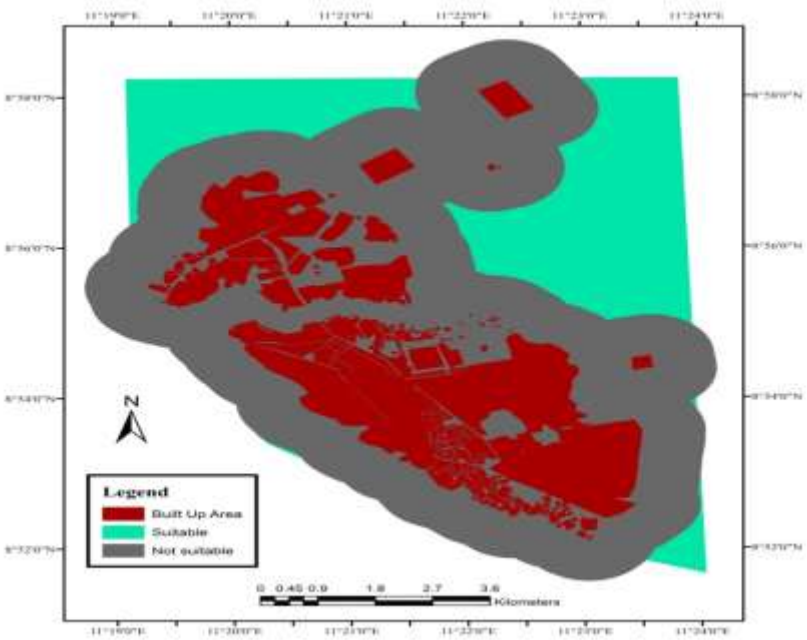

Figure 3: Buffered Built up Area map.

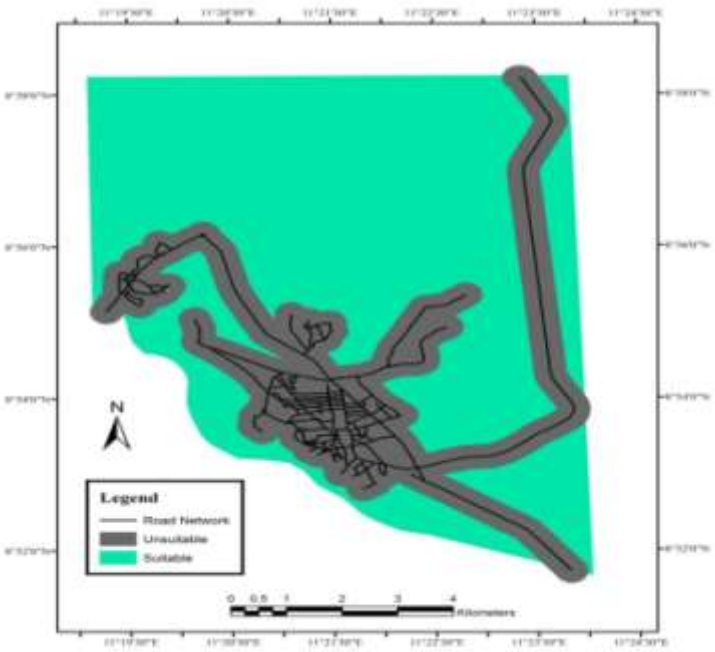

Figure 4: Buffered Road network

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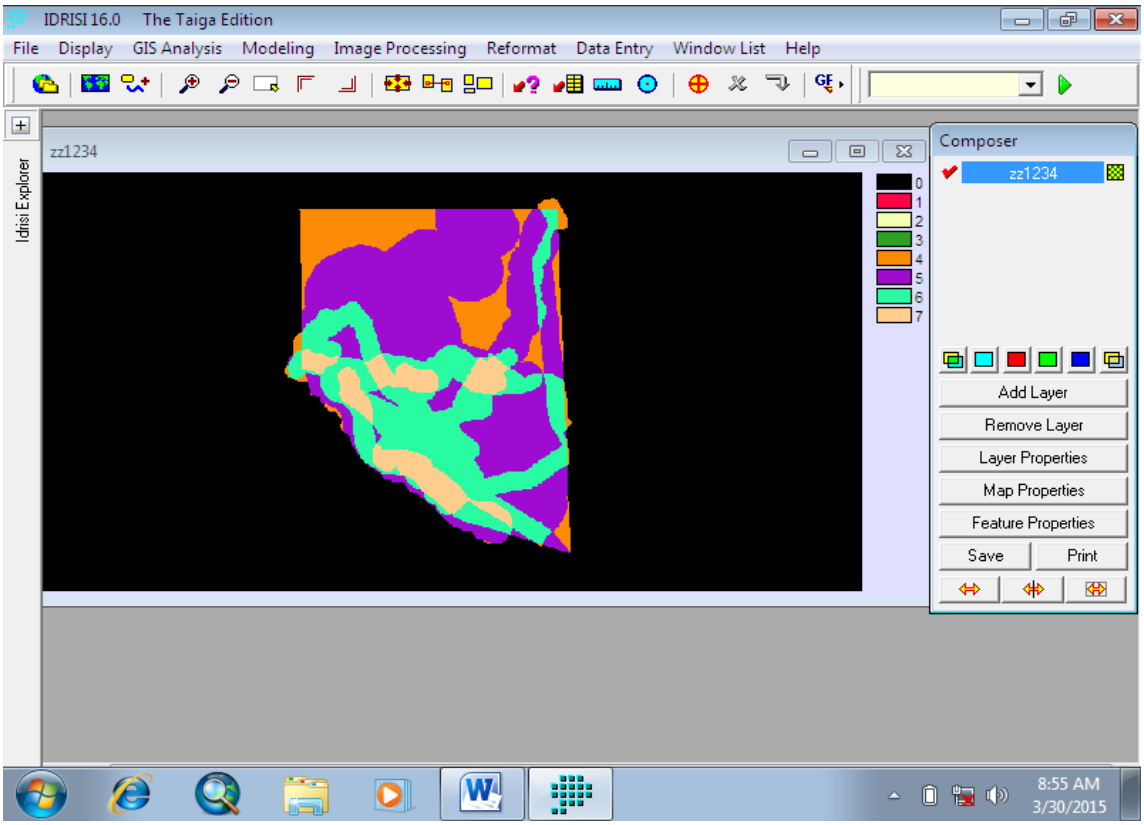

Figure 5: Suitability map

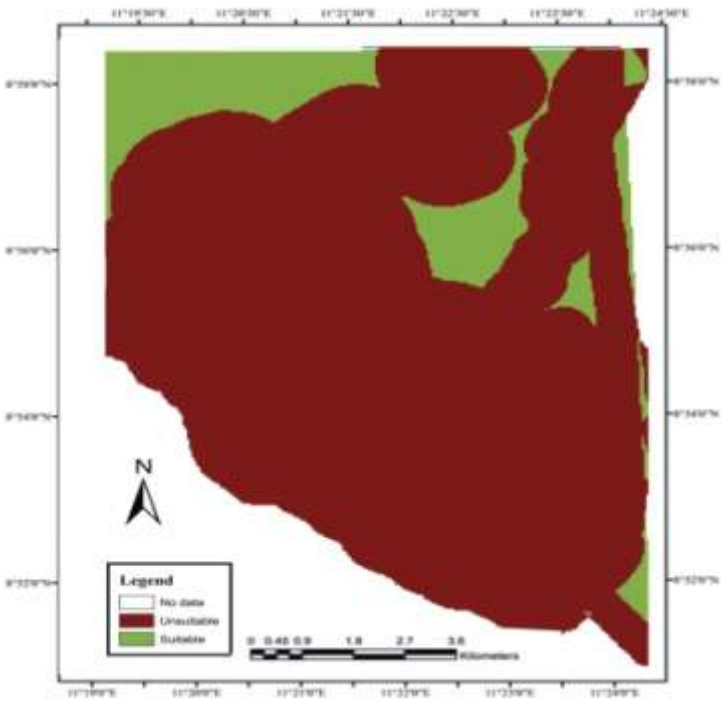

Figure 6: Suitable Area

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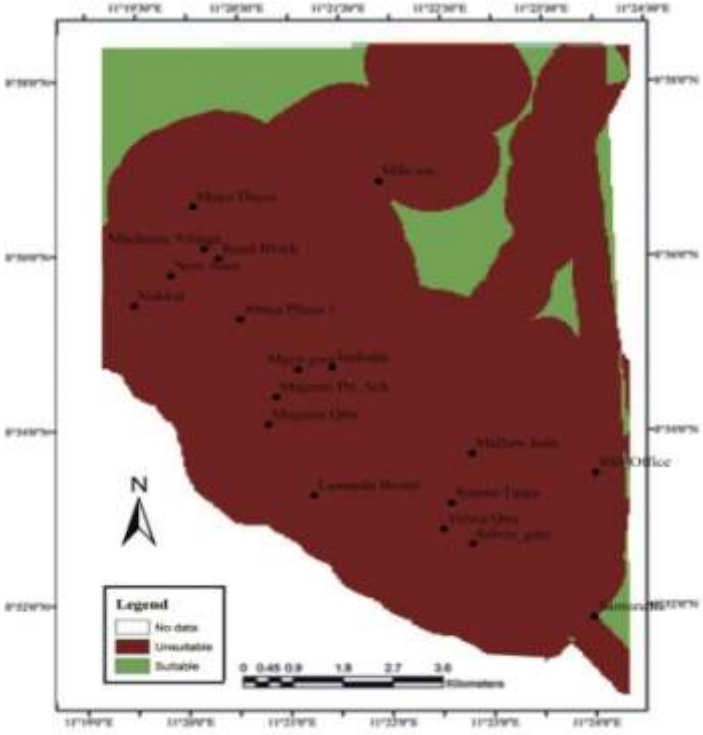

Figure 7: Suitability Verification Map

3.3 Findings

The use of remote sensing and GIS techniques for site suitability study cannot be over emphasized, the technique brings real, authentic and highly technological and scientific results. The system combines data, mapping and image processing and statistical analysis in a single frame work.

This study used GIS integrated standard methodology for the selection of site, which are suitable for the disposal of waste in the study area. In the study, a number of environmental factors such as major drainage buffer zones, settlement and economic factors like road network as well as physical factors like topography were incorporated in the modeling of the suitability site for waste disposal. Integrating these data using GIS techniques has helped in the analysis of the study which would have otherwise been difficult if manual or conventional method were used. However, from the result of the analysis, it was observed that the areas that are "unsuitable" for waste disposal were found around the central business district. Where most human activities such as commercial activities, hospitality and town residential houses are based, while the northern parts and few areas in the southern part of the study area were found to be "suitable". These areas are found to be scantly inhabited relatively lowland areas with few or no water bodies.

IV. CONCLUSION AND RECOMMENDATION

4.1. Conclusion

From the above findings, conclusion was deduced that the extreme north west of the study area and few parts of south east were found to be suitable for waste disposal.It was also revealed from the study that almost all the existing waste disposal sites are found in unsuitable areas which put the health situation of the inhabitants at risk.

Finally this approach is easy to understand and it can illustrate which areas are unsuitable, and suitable for waste disposal sites. The criteria used in this study are not fixed since it can vary from area to area.

4.2. Recommendation

Remote Sensing and GIS techniques for decision making in environmental monitoring and resource allocation has become a necessity for environmental planners and other related areas. Based on the above findings the following, recommendations are made:

1. Ministry of Environment, federal environmental protection agencies and other

stake holders should ensure proper selection of waste disposal site in our cities by using reliable and timely technology such as GIS and remote sensing for solutions to environmental problems.

2. The state and local government authorities concern should immediately stop the disposal of waste at the existing dump sites and relocate same to suitable area as the existing dump sites were found to be unsuitable.
3. A clear policy on the mode of waste disposal be established by government and public awareness be created to sensitize all levels of society on public conceptions, interpretation and perception of solid waste management practices so as not to underestimate the significance of proper municipal solid waste

It is believed that when this is done, waste could in the near future become wealth while leaving a healthy environment for effective productive life as waste is caused by man`s technology, hence this technology will efficiently and effectively manage it.

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