

Impact of Public Solid Waste Disposal Dump Sites: A Threat to Residence of Yelwa Tsakani, Bauchi

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ABSTRACT

The nature of the waste disposal has caused environmental health threat to Yelwa Tsakani communities. The effect of siting waste dumpsite closer to residential buildings causes health challenges such as malaria, diarrhoea, and respiratory diseases, skin, nose, and eye irritation, gastrointestinal issues, fatigue, headaches, and psychological issues, as well as allergies. Geospatial techniques were used to determine the proximity of the dumpsite to residential buildings and how spatially distributed are the dumpsite locations; the study used the field survey and questionnaire to gather the spatial and non-spatial data. The spatial data were obtained using remote sensing and ground survey method. Nonspatial data were obtained using questionnaires analyzed accordingly and the finding shows the impact of the waste disposal to residence; 86% of the dumpsite poses health threat such as pollution and sickness. Furthermore, chemical and biological content substance of the waste may sink down and contaminate the water body. The route analysis conducted shows that 44% of the waste dumpsite are located within the remote areas that are not accessible for evacuation by trucks and also 73% of the dumpsite are situated without adhering to the environmental protection directives regulation. People living around it may experience health related challenges. In-view of this, it was recommended that the BASEPA should create a database management system for monitoring and evaluation for waste dumpsite, and also recommend site in the community for building dumpsite that will help in combatting the community's health threat due to waste disposal and also introducing geospatial technology to their operation which will help in identifying vulnerable community for mitigation.

INTRODUCTION

Over the centuries, disposal of waste has been the major concern in developing nations and the main aim behind the rising concern for waste production and disposal are rapid increase in the urban uncontrollable settlement, which result from over-population growth. The indiscriminate disposal of waste which is normally practiced around populated environment poses health hazards. Mostly the lifestyle of the urban area changes, and growing population are primarily responsible for the increasing amount of waste generated in the environment (Angaye and Abowei 2017; Hossein et al. 2018).

Waste is any unavoidable material generated from domestic and non-domestic activity or industrial operation that is not of economic demand and must be disposed of; such wastes are classified as toxic and non-toxic substance. Toxic substances are normally gas emissions from open burning waste disposal dumpsite which may be caused by uncontrolled and poorly managed landfills of trashes which then decompose into organic waste in the landfills releasing greenhouse gases and pollutes the surrounding the environment, soil and water bodies (Lim et al. 2016; Srivastava et al. 2015). The environmental protection agencies authority in most developing countries lack the resources to support the fast-growing communities with the necessary facilities that would control the indiscriminate disposal of waste so as to improve the

healthy lifestyle condition of the population (United States Environmental Protection Agency, USEPA 2019).

Nigeria generated an estimated waste of about 32 million tonnes annually across the country with the population of over 200 million people and 60% of wastes collected in Nigeria are organic waste, and only 40% are recovered are refuse from Business Opportunity in Nigeria waste according to Circular Economy Sector Report (2020). The refuse generated includes garbage or refuse discharged from the residential, market, institutional, and industrial activities. The quantity of waste generated depends on several factors such as food habits, standards of living, economic status, and the degree of commercial activities.

The outbreak of various diseases was linked to the illegal disposal of waste (MSW). People who live around the garbage-strewn neighbourhood are more likely to have malaria, diarrhoea, and respiratory diseases, skin, nose, and eye irritation, gastrointestinal issues, fatigue, headaches, and psychological issues, as well as allergies (Zohoori and Ghani 2017). Individuals may also be exposed to a variety of diseases most especially when toxics substance from the MSW sink down and contaminated water that is been used for drinking, bathing, and irrigation purposes (Vineet, et'al.,2022).

Improper disposal of waste also includes sharp objects (such as syringes, razors, and blades) that directly pose serious health hazards to waste pickers and disposal workers. Survey data revealed that more than 250 million people are infected with Hepatitis B virus,70 million with Hepatitis C, and 38 million with immune deficiency infections worldwide, primarily due to exposure to infected syringes and blades (Karshima,2016 and Satterthwaite et al, 2018)

In Yelwan Tsakani, Bauchi, like other states is not exceptional of the happening, wastes are commonly dumped in open sites and uncontrolled landfills. According to the World Bank reported shows that 90% of the waste is often deposited in unregulated dumps or openly dumpsite. The practices create serious health challenges and environmental consequences. Waste collection service is organized by the state government or burnt in any available open space within the neighborhood of residential areas.



Plate 1. Dumpsite 1

Geographical information system (GIS) is a digital database management system designed to manage large volumes of spatially distributed data from various sources that is being used for geospatial analysis. In most cases information about the surface of the earth is acquired using instruments which are remote to the earth's surface, usually from aircraft or satellites" (Lwin, 2018). Data can be collected on relatively large geographic area very quickly using remote sensing technology. These capabilities, when properly harnessed, helps forest managers make well-informed decision on the forest they are managing. These tools have been used in many parts of the world and have been proven to be very effective (Cillis et al., 2021; Picchio et al., 2019;)

In Nigeria, despite several research studies illustrating the effectiveness of GIS technology in monitoring and managing Waste disposal, its benefit is yet to be harness for the management of most solid waste (Akinola and Akindele, 2020; Oke et al., 2020). Sustainable solid waste management in Nigeria has been faced with a lot of challenges, some of which are poor management, outdated environmental protection management plans, inadequate manpower, and outdated information on the size and extent of wates dumpsite in Nigeria (Olukwu-Kalu et al., 2022). Some of these can be solved by adopting RS and GIS

technology. However, there seems to be a gap between research findings, recommendations and actual implementation. This article therefore seeks to review the importance of RS and GIS technology in solving some waste management problems and likely challenges encountered in the adoption of such technology in public waste management in Nigeria.

Actualization of the logical distribution pattern of dumpsite in respect to impact of waste disposal to residence; a study was carried out utilizing nearest neighbour analysis (NNA) and proximity analysis as the statistical tool. The proximity analysis is used to determine the accessibility of the school's security and safety (route distance). Using buffer analysis to identify security and Al-Rasheed et al., 2013).

Statement of the Problem

In recent years, communities in the Urban and Rural settlement have faced a variety of negative impact of waste disposal to its residents; the uncontrolled dumpsite which has grown over time from a small dump to a large unmanaged waste site pose health threat to the residence. Yelwan Tsakani is not exception of the waste impact in most cases garbage-strewn neighbourhood are more likely to have malaria, diarrhoeal, and respiratory diseases, skin, nose, and eye irritation, gastrointestinal issues, fatigue, headaches, and psychological issues, as well as allergies. As the waste decomposes, it poses a health hazard to those living close to it, and also release gases that are explosive and flammable and also air pollution whenever it is being burnt pose environmental hazard to the community.

Spatial distribution analysis will provide detailed information about areas that are more exposed to health threats due to the indiscriminate disposal of the waste by displaying the nearest neighbor's analysis of the area in accordance to its inter-visibility, descriptive, and location in order to improve and enhance the level of environmental safety of the community and also provide solutions to the problems of health threat that the communities are facing. The geospatial technique is used to analyze location in the community that are most vulnerable due to indiscriminate disposal of waste.



Plate 2. Dumpsite 2

Aim and Objectives of the Study

This study aims at analysing the Impact of Public Solid Waste Disposal Dump Sites to Residence. Yelwa Tsakani as a case study to identify dumpsites that are a threat to the community in accordance with the regulations of National Environmental Protection Agency. This will be achieved through the following objectives:

This study will be useful to the National Environmental Protection Agency such as Bauchi State Environmental Protection Agency (BASEPA) and the communities. Furthermore, it will reveal areas that are exposed to health threats the disposal of waste, it will analyze and recommend point that government can build disposal facilities for the environmental safety.

Scope of the Study

The study will be conducted in the Bauchi Local Government Area of Bauchi state and This research study focuses improving the health safety of the people living in Yelwa community. Therefore, it will be concentrated on the safety of the community. In addition, this study will also be limited in terms of time, resource availability, and being cross-sectional data. Nevertheless, the result of this study will have practical validity mainly to an area with peculiar cases and can be used as a reference for other similar areas.

LITERATURE REVIEW

Introduction

The literature reviews previous empirical researches related to Impact of Solid Waste Disposal Dump Sites to Residence. It is no longer news in the country that indiscriminate disposal of waste has resulted in numerous health hazard which seasonally leads to the outbreaks of diseases which eventually lead to loss of human lives both in the rural and the urban settlement. Geospatial technique is used to improve the safety of lives in the environment by determining the proximity of waste dumpsite to the residence and also the effectiveness of the environmental protection agencies who are responsible for regulating the improper disposal of waste. GIS provide advanced analysis tools and complete data packages for proximity analysis which can be used to analyze the safety facilities in case of emergency and demographic information (Shoman *et al.*, 2018). These tools aid in analyzing the level of the school vulnerability to security threat in the location, while also highlighting the optimal route for safety

Concept of Geospatial Information

The advancement of modern technologies in the production of geospatial information exposed the possibility of incorporating new methods of acquiring data, research, and documentation in countless applications in the field of Geoinformatics. The use of satellite imagery techniques with a Remotely Piloted drone or Aircraft Systems (RPDAS) in maps production has experienced tremendous improvements globally. The usefulness of this method can be attributed to its speed, affordability, and efficiency when generating high-resolution data sets, including Digital Elevation Models (DEM) and orthophotos; it can also be used for 3D mapping (Nex and Remondino, 2014) and to achieve accurate georeference of geospatial distribution products from satellite imagery maps or the piloted drone system image. Ground Coordinate Points (GCPs) are used to show the actual position of an object on the Map and represent a substantial portion of the overall survey work (James *et al.*, 2017).

Concept of Geographical Information System (GIS)

Geographical information systems are computer installed software that uses series of designed procedures to support the capturing manipulation, analysis, and display of spatially referenced data for solving complex planning and management problems. Additionally, it is used to store and analyze extensive information in a map-based format, thus allowing for easy retrieval and manipulation of information for the basis of new analysis on spatial relationships between sites of interest and any combination of available data sets (Wahyuningtyas. *et al.*, 2020). It is capable of acquiring spatially indexed data from a variety of sources, changing the data into useful formats, storing, retrieving, and manipulating the data for analysis, and then generate the output required by the user. The great task is based on the ability to handle a large multi-layered database and to query its existence, location, and properties of a wide range of spatial data objects.

GIS uniqueness is attributed to its rapid analysis and display of data, with flexibility not possible using the manual method because it does not hold maps or pictures rather it holds a database (Chang, 2010). Geographical information systems use different steps in order to either analyze data or produce map

Solid waste

Waste are unwanted material from domestic, commercial, agricultural, industrial activities, and public services that are been deposited on either land or water as a means of disposal which affect and life of residents. The problem of waste management is a global environmental issue which has caused much havoc in our society. Most of the waste generated emanated from human and animal activities and are usually discarded as useless or unwarranted materials. Rapid growth in population, industrialization, and urbanization are responsible for vast amounts of waste being generated every day. Waste disposal is an integral part of the waste management system, which requires much attention to avoid environmental pollution. Substantial waste disposals can be carried out by composting, vermiculture, recycling, incineration, and landfilling methods. A solid waste disposal site is a land disposal site for non-hazardous solid wastes. Waste is spread in layers, compacted to the smallest practical volume, and covered with materials The implication is serious when a country is growing rapidly and strategies of how to manage waste effectively are not put in place. Evaluations of solid waste management practices in developed and developing countries show that the latter lack technical know-how and also show low commitment to the issue of waste management compared to the former (Ike et al.2018; Ferronato and Torrenta 2019; Azevedo et al. 2020)

in Nigeria, like most developing countries, wastes are commonly dumped in open area, which may become uncontrollable landfills. Environmental protection agencies may not have easy access to the waste for evacuation; such wastes can only be burnt in such area and the effect of the hazard may lead to outbreak of diseases within the neighbourhoods of residences. This concern has attracted this research to identify the hotspots for these indiscriminate dumping of solid wastes and organize a schedule for their evacuation from households in the Bauchi metropolis (Shashikumar, 2012).

Problem of Solid Waste Disposal Dumpsite

The Solid waste management has been the major environmental problems in most Nigeria urban settlement, Waste is the most popular and difficult substance to manage locally among all the scraps (solid, liquid, and gas). Solid waste does not flow, evaporate, diffuse, dissolve or be absorbed into the surroundings, unlike liquid and gaseous wastes. Waste generation rate in Nigeria is estimated at 0.65-0.95 kg/capita/day which gives an average of 42 million tonnes of wastes generated annually. This is more than half of 62 million tonnes of waste generated in sub-Sahara Africa annually and where and how to channel these wastes becomes a huge problem for the nation. The problem of waste management is even becoming more complex with the increasing rate of urbanization. Problems in solid waste management are mainly attributed to inadequate equipment and staff and the inefficiencies associated with central Government Agencies and in most cases waste management in Nigerian cities is largely monopolized by the agencies of state governments (sub-national governments) which have limited capacity to tackle the problems of solid waste management in their cities. In addition, 52 % of wastes generated are organic wastes which creates additional disposal problems. Although the problems of solid waste management in Nigeria range from poor collection and disposal methods; lack or poor waste management database; insufficient financial resources; non-compliance to laws and lack of awareness on dangers of poor sanitary habits, this paper argues that a robust waste data base, strict policies and regulation are important for effective solid waste management in Nigeria (Ike, et'al,2018)



Plate 3. Yelwan Tsakani waste

Solid Waste Disposal

There is a significant amount of waste disposal in Nigeria that is not properly segregated, causing economic and environmental harm. It is preferable to segregate waste and trash at the initial stage of generation rather than the least inconvenient and costly option. There must be proper waste management planning based on an analysis of the waste situation in the area. Waste management is primarily divided into two stages. The first is waste management where it is generated, and the second is waste management at dumping grounds. This includes concerns about waste generation, image, collection, and removal from collection points. The current Waste Management System has numerous flaws. For instance, placing waste bins in the incorrect position, processing rubbish several times by hand, not having separate bins for recyclable waste, and polluting natural water streams because of bin proximity.



Plate 4. Waste in Yelwa Tsakani Bauchi

The discharge, deposit, injection, dumping, spilling, leaking, or placement of any solid waste into or on any land or water is referred to as solid waste disposal. This definition excludes the transportation, storage, and treatment of solid waste. Some criteria for selecting the best location for a waste disposal facility, according to Oluwagbemiga et al (2022), are:

1. The site must be beyond 20m of existing streams
2. The site must be more than 160m from sensitive areas such as endangered species habitats or recharge zones of aquifers
3. The site must be within 300m of a major road
4. The site must be more than 200m away from any existing hazardous waste production facility or waste site

Also, Srinivas et al. (2002) stated some determining criteria for city garbage collection sites:

1. Waste deposition should be within 250m of a lake or river
2. Waste deposition should be within an area deemed protected because of wetland or 100 years of the flood plain.
3. Waste deposition should be within 500m of an occupied residential dwelling, bedded health care facility, prison, lower educational institution, or children's pre-school.
4. Waste deposition should be within 1,500m up gradient or 500m downgradient of a public or private water supply well existing or established as a potential supply.
5. Waste deposition should be at a junction to facilitate easy turning of the carrier trucks

Considering the literature review's facts, appropriate criteria are being considered for appraising the suitability of refuse collection points (waste bins) in Ado-Ekiti State capital.

The volumes of solid waste in many Nigerian cities, has overwhelmed the capacity of urban administrators to manage it. Only about 30-50% of the generated waste is collected in most Nigerian cities, and recycling trash is not practiced significantly (United Nations System in Nigeria, 2001 and also wider gap was discovered between waste generation and evacuation rate in most cities and this is due to the high rate of indiscriminate disposal of waste in urban settlement in the country. Hence, the solid waste disposal problem is experienced in most cities of the Nation Over the last 50 years, Urban population of Nigeria grew substantially from 19 to 53.5% rising at an increasing annual rate that reached a maximum of 3.19% and then decreased to 1.47 in 2022; this implies a high urban growth rate. The problem of waste management is one of the consequences of this high growth rate. The inadequate management of solid waste is causing many problems to the local environment since these wastes are often indiscriminately dumped on open plots of land and mainly along or on streets. The unsanitary conditions of collecting, processing, and disposing solid waste contribute immensely to urban environmental degradation. Those found on drains obstruct the free flow of water, resulting in urban flooding, which destroys lives and properties and displaces people (Mohammed, et'al.,2022).

Preliminary investigation show that a health safety of an environment is seen critical to life. However, various studies in recent years have shown that communities are not so safe anymore due to some health threat from the disposal of waste, the environmental protection agencies are left with the responsibility of providing a safe environment for people. Most communities are faced with numerous issues involving environmental pollution safety which is artificial disasters, preventing indiscriminate waste disposal and protection of life are seen responsible for ensuring that people are safe in the community. To the best of researcher 's knowledge and from available literatures, none of the environmental protection agencies have used geospatial approach health safety of the environment in Bauchi. This research tends to use geospatial technology to show areas that are more suitable for disposal of waste analysis.

METHODOLOGY

Introduction

This section discusses the study area and the main points provided in detail: A brief description of the research design, data, and study area, as well as the research methodology (using GIS techniques). The image of the research design is presented through which the structural flow of the research can be understood, data types used in the research, and their sources and methods of collection are clearly described.

Research Plan

The conceptual structure of the research work shows that the research will follow step by step procedure as embarking on flowchart reconnaissance (Office and Field). Data will be collected from primary and secondary sources and, using geospatial techniques, the data collected will be analyzed, and necessary recommendations will be given in order to enhance security deployment and improve school safety in

Bauchi.

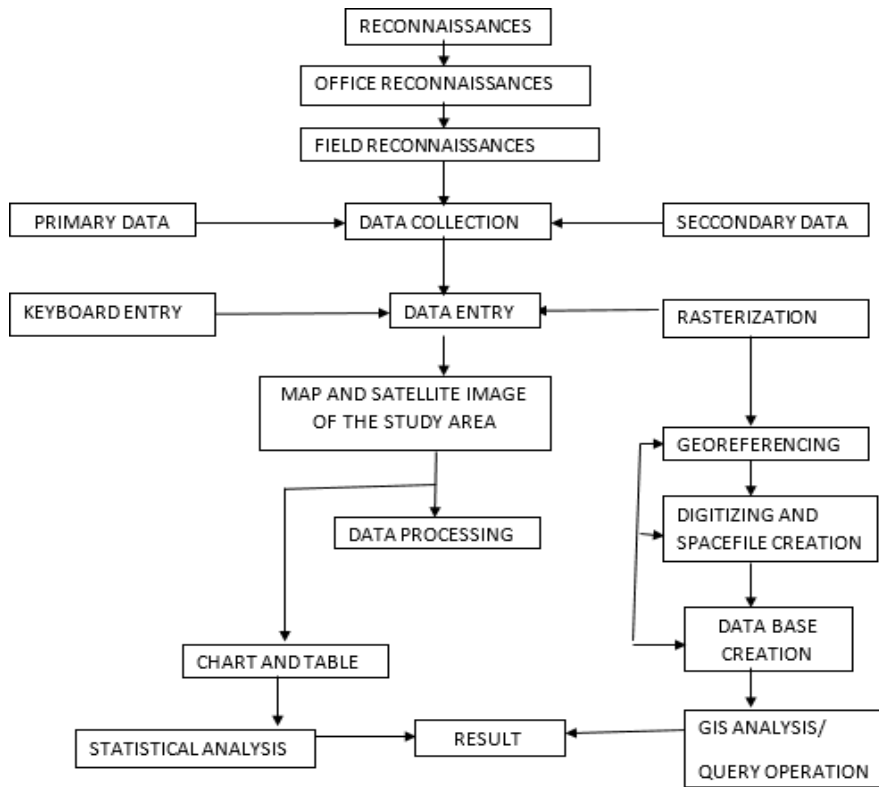


Fig 1. Methodology Flow Chat

Location of the Study Area

The study area is Bauchi central Senatorial District, which Bauchi Local Government Areas (LGAs) of Bauchi State, Nigeria. Geographically, it is located between the latitude 10 15’26.23”and 10 16’30.25” North of the equator and longitude 9 46’36.32” and 9 47’44.94” East of the Greenwich meridian. It covers a surface area of about 3, 687 km² and has an estimated population of 493, 810 (NPC, 2008).

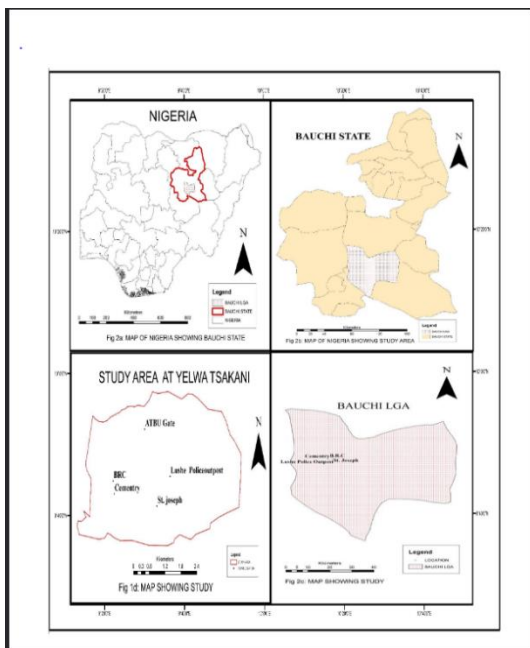


Figure 2. Map of Study Area

Sources of Data Requirements

The data were sourced from both primary and secondary sources:

Primary Data: The primary data were sourced from the field. The research method employed fieldwork such as 1) collecting the coordinates of the primary school point and security agency stations using the Geographical Positioning System (G.P.S.).

Secondary Data: Satellite images of the area were downloaded from Google map. The satellite images were used to identify and extract the relevant features. Attribute information about these base stations were collected from the telecommunication service operators. The data included the following:

1. The names of the various primary schools and security agency posts or stations
1. The address and location of the primary schools and security agency post or stations.
1. The study area contains a large number of primary schools and security agency posts or stations.
2. Ownership and characteristics of each facility.

Data Collection

The first and most important stage in any survey work is reconnaissance, which requires the researcher to visit the study area to get familiar with its features and take note of possible difficulties encountered in the course of the work. There are two types of reconnaissance: office and field reconnaissance.

Reconnaissance

Office Reconnaissance: This is also known as the planning stage. It involves making the necessary arrangements and/or preparation work to be carried out to ensure the proper execution of the project and obtaining the relevant materials used in its execution. Some of the materials obtained are:

1. A map of the study area was obtained from Sas planet, USGE, and Terra Incognita.
2. Information about the location and characteristics of the primary schools and security agencies were obtained from Bauchi State Primary Education Board and security agencies.
3. The extent of the study area.

Field Reconnaissance: A reconnaissance survey was carried out to provide information on the location of the primary school and a security agency post or station in the metropolis. Other relevant information and attribute data were obtained by visiting the primary school and security agency station using a handheld G.P.S. receiver and interacting with some stakeholders using a Key Informant Interview (K.I.I.).

Data Processing

The steps employed was through Image Georeferencing. The high-resolution image of the area (0.5m) was georeferenced with the aid of ground control points by creating a geographical coordinate system using zone 32 W.G.S. 1984 (Bauchi metropolis is in Zone 32 on the Universal Traverse Mercator) to facilitate geospatial processing and analysis. ArcGIS 10.3.1 software was used for the georeferencing and digitizing exercises. The image georeferencing was done properly by clicking on the georeferencing tab and clicking the add control tab (where four evenly distributed ground control points coordinates will be added to the

image). The image was then geo-registered by creating a geographical coordinate system using zone 32 North of Minna data to facilitate geospatial processing and analysis.

Data Analysis

The data containing the relevant vector shapefiles were checked and imported into the ArcGIS environment to create a visual map of point and polygon feature classes. The X and Y coordinates of the facilities automatically displayed the locations of all the base stations on the map which shows the distribution of the facilities across the study location. Using the geospatial techniques, **the vectorized map of the study location was imported and all the relevant shapefiles were spatially overlaid.** Subsequently, the proximity analysis and “Nearest Neighbor Analysis” (N.N.A.) inferential statistical tool in ArcGIS 10.7.1 was computed to establish the spatial pattern that exist in the data. Nearest Neighbor Analysis is the method of exploring patterns in the location data by comparing the mean distance (Do) of the phenomena in question to the same expected mean distance (De) under a random distribution.

PRESENTATION OF RESULTS, DISCUSSION AND INTERPRETATION

The Dynamics of Impact of Dumpsite to Yelwa Tsakani community

Indiscriminate waste disposal is one of the environmental health threat challenges Yelwa Tsakani is seriously facing. Looking at trend of waste disposal over years, research has shown that areas that has much of the indiscriminate disposal of waste tend to experience outbreak of diseases such as malaria, diarrheal, and respiratory diseases, skin, nose, and eye irritation, gastrointestinal issues, fatigue, headaches, and psychological issues, as well as allergies. The state environmental protection agencies can only regulate waste disposal within the government residential area. The researcher uses geospatial techniques and statistical analysis approach to achieve the result. The dumpsite where identified, suitability and proximity analysis were used to analyze and give recommendation respectively.

Identified and Geospatially Locate and Analyzed the Proximity of the Solid Waste Disposal from Houses

The geospatial analysis shown below gives the spatial descriptive of dumpsite location in relation to the residential building around Yelwa Tsakani, following the standard regulation of the environmental protection agencies of the allowable distance which is 30-40m away of houses from waste disposal dumpsite. This study identified 37 waste dumpsites within the community, geospatial and statistical analysis was used to show how spatial distributed are the waste disposal dumpsite from the residential buildings wells. Well and residence criteria indicators were used to determine the house vulnerable base on the closeness of the waste dumpsite to well and buildings. The geospatial and statistics shows that most residential houses and their well fall with 30m buffer which means that they are prone to health threat due to the non-compliance to the national standard of environmental protection agencies on sitting dumpsite. 86.48% of buildings around the identified dumpsite are within the buffer zone of 30m are vulnerable and 13.48% are outside the buffer zone of 30m which mean that they are not vulnerable. These implies that being that 86.48% of the dumpsite pose threat to health such as pollutant which may lead to malaria, diarrheal, and respiratory diseases, skin, nose, and eye irritation, gastrointestinal issues, fatigue, headaches, and psychological issues, as well as allergies and furthermore, chemical and biological content substance of the waste may sink down and contaminate the water body.

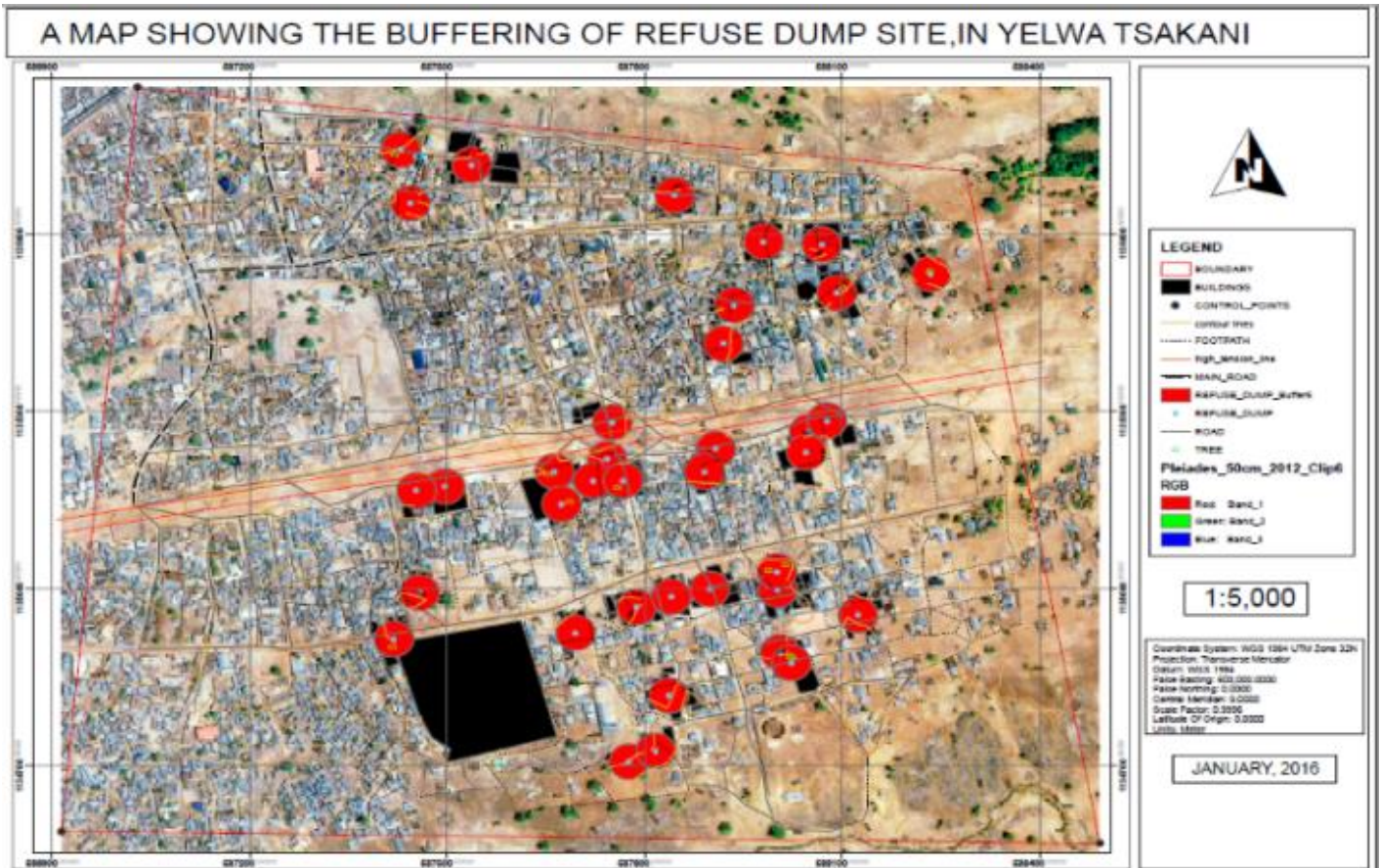


Figure 3. Map Showing the Buffering of Refuse Dumpsite

Areas Vulnerable to Waste Disposal Health Threats.

The geospatial and statistical approaches used shows that 86.48% of the residential are vulnerable and the impact of the waste closeness affect the residence by causing health challenges to people and also contaminate the well which are normally used as for drinking water and other domestic purposes such as cooking. The geospatial analysis conducted shows that 44% of the waste dumpsite are located less than 10m away from the house and because of how remote the areas are, the waste is not accessible for evacuation by state government waste disposal trucks. In most cases the dumpsite happens to be the major disposal site and cannot be accessed; the only alternative the community has is to burn the waste in that particular location. The air pollution caused by the burning of the waste pose environmental health threat which sometimes may result to outbreak of diseases, 27% of the waste are accessible for evacuation and such waste are not being evaluated due to poor government policy on environmental protection. The government do not have knowledge of most of the dumpsite which means that 78% of the dumpsite are sighted due to population density of the communities and government do not make provision for the disposal. In most of the cases, the communities decide to choose a disposal point without following suitability criteria analysis for the selection. The findings have shown that 72.97% of the dumpsite are situated without adhering to the environmental protection directives regulation, people living around it may experience health related challenges due to the effect of the waste burning.

The digital elevation model (DEM) of study area in relation to the location of the waste dumpsite shows that 68.40% of the dumpsite are situated wrongly, the toxic waste deposited when sink down contaminate the sources of drinking water available within the communities.

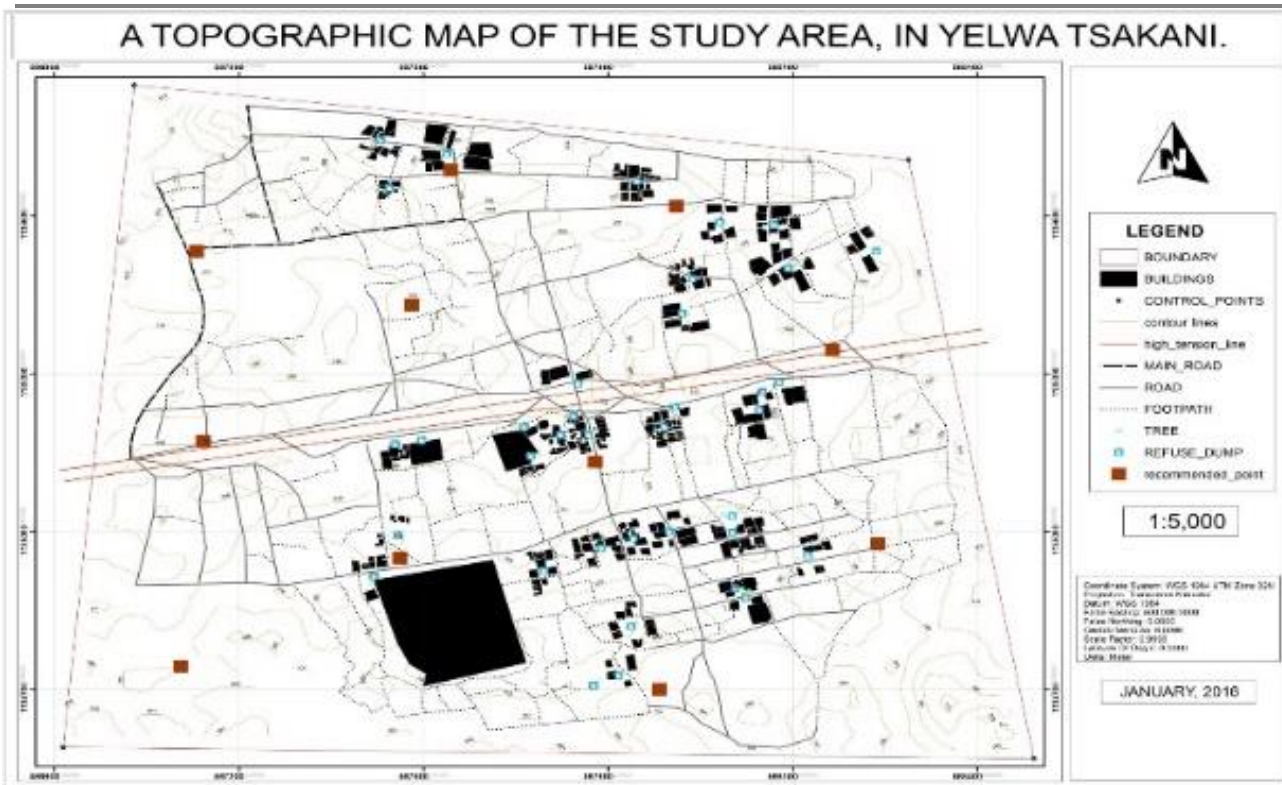


Figure 4. Topographic Map showing affected buildings

Furthermore, the table beneath shows the responses of the interviewers on how most of the waste disposal site were selected.

Table 1: How did this place become a waste disposal site

	Frequency	Percent	Cumulative percent
The government provided the place.	3	6.0	6.0
The people saw it vacant and started disposing of waste on it.	28	56.0	62.0
The community chose it as a waste disposal site.	5	10.0	72.0
I do not know how it came about a waste disposal site.	14	28.0	100.0
Total	50	100.0	

Bauchi State Environmental Protection Agency (BASEPA) Management of the Dumpsite.

The table below shows the level of Bauchi State Environment Protection Agency (BASEPA) performance in the management of waste in Yelwan Tsakani. The data shows 62% of the interviewers said that the dumpsite are poorly managed by BASEPA, 12% of the interviewers said that the BASEPA are very poor in management of waste, 18% and 8% of the interviewers said that BASEPA are very good in the management of waste, and also, the functionality of BASEPA in the evacuation of waste disposal shows that 66% of the interviewer said BASEPA do not evacuate waste disposed, 20% of the interviewers said that the waste is evacuated after three months, 6% of the interviewers said that the waste is evacuated after two months , 6% of the interviewers said that the waste is evacuated after one month (1) and finally 2% of the interviewers said that the waste is evacuated after two weeks. The findings shows that waste disposed are not properly managed by BASEPA.

Table 2: Assess BASEPA in the direction of the dumpsite in Yelwa Tsakani

		Frequency	Percent	Cumulative Percent
	Poor	31	62.0	62.0
	Very poor	6	12.0	74.0
	Good	9	18.0	92.0
	Very good	4	8.0	100.0
	Total	50	100.0	

SUITABLE WASTE DUMPSITE DISPOSAL RECOMMENDATION

Geospatial technology was used to produce thematic map that shows most suitable location for siting solid waste disposal dumpsite. Criteria analysis was putting into consideration to ensured that the recommended location is not prone to any health challenges to the residents of the location. Considering the fact that Environmental safety are the fundamentals, proximity analysis and suitability model of area was done to the suitability of the location.

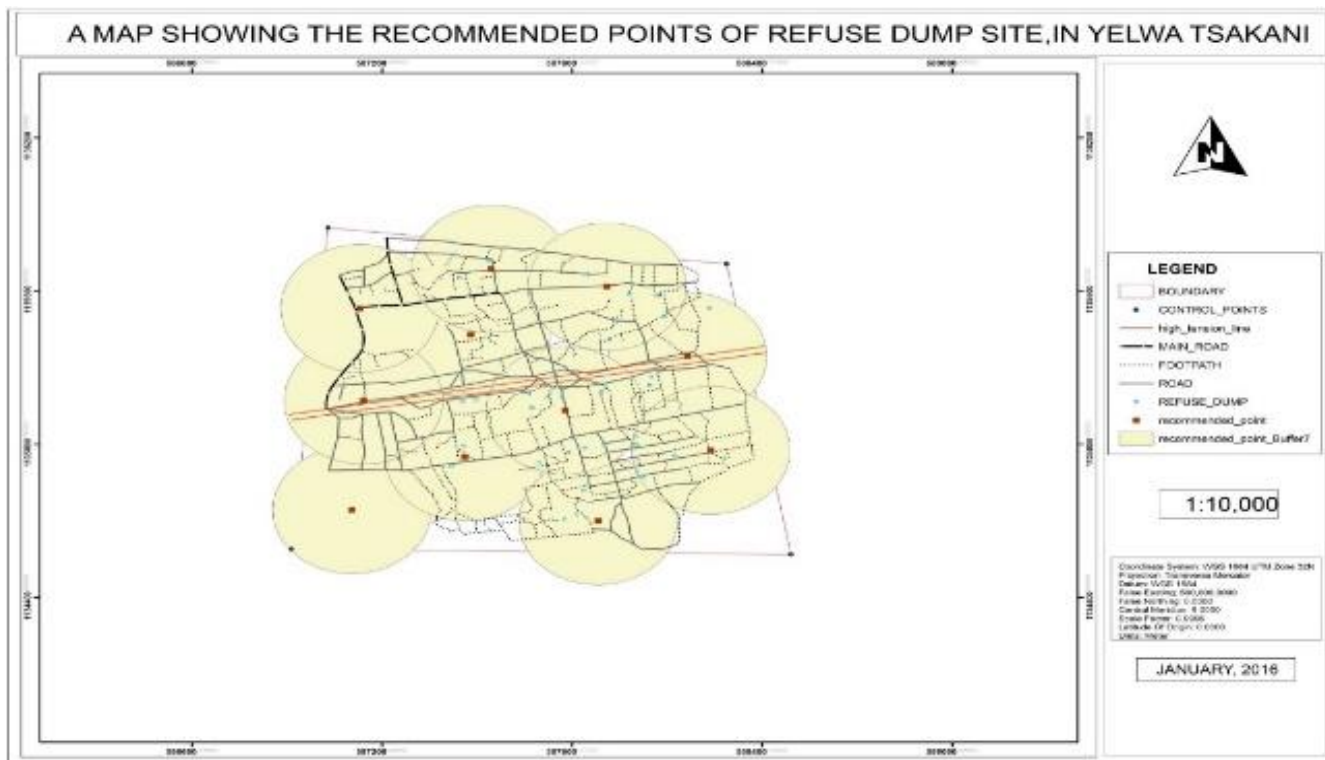


Figure 5. Map Showing Recommended Refuse Dumpsite

CONCLUSION AND RECOMMENDATIONS

Conclusion

The indiscriminately disposed waste poses health threat to the community, 86% of the dispose waste are harmful to the residences of the environment, and the nature of the waste disposal has caused environmental health threat to Yelwa Tsakani communities. the effect of siting waste dumpsite closer to residential buildings causes health challenges such as malaria, diarrhoea, and respiratory diseases, skin, nose, and eye irritation, gastrointestinal issues, fatigue, headaches, and psychological issues, as well as allergies.56% of the dumpsite are not accessible for evacuating the waste, hence are burnt by the people. The inability of the community to selected proper place for the disposal of their waste, the toxic substances deposited which sink contaminants into the drinking water around and subject most of the vulnerable members of the

community health threat. Geospatial technique was adopted to map out area that are more suitable for dumping of waste without affecting the health condition of people living in the community.

Recommendations

Based on the above, the following recommendations are made:

1. If dumps must be used, they should be adequately planned, monitored, and sited away from residential buildings, schools, and other infrastructural facilities using Geospatial approach. They should also be adequately protected and regularly evacuated to stop the breeding of pests and rodents, and pollution of air and water.
2. According to Henry Adams, “Neither history nor economics can be intelligently studied without a continual reference to the geographical surroundings which have affected nations in different ways.” Hence, GIS is used to analyze the level of impact made by waste in the environment for decision makers to look for solution for the problems analytically.
3. The use of GIS technology is recommended due to the following:
4. 80 % of the information used by environmental management officials has a spatial component.
5. Easy integration of information from various levels of jurisdiction.

Ease of simulating voluminous information for analysis.

1. Maps and spatial data will become the way of their routine.
2. Easy storage of correctly updated data.
3. BASEPA should put in place a comprehensive and cohesive system to handle a large amount of data. This will assist in the future distribution of waste bins and the dumpsites.
4. The current waste management strategies should shift from simply moving the waste from one site to another and not managing it. The Integrated Waste Management (IWM) concept should be adopted. The ultimate aim of Reduce, Reuse, and Recycle (3R’s of IWM) is to reduce the amount of urban waste that would eventually end up in landfills, incinerators, or other waste management facilities. Better design of packaging can reduce waste by 10%; recycling by about 30% while large scale composting can achieve 10% reduction. This implies that recycling is the major player in the removal of urban waste streams (Botkin and Keller, 1998). High recycling rates of clean, source-separated materials should be encouraged. This can be achieved through Public-Private Partnership (PPP).
5. Education and Enlightenment or sensitization programs should be intensified and brought down to the grassroots. Proper education on the hazards of the indiscriminate refuse disposal should be made available. It should be incorporated into the school curriculum at both primary and secondary levels. The media publicity is not enough since not everyone has access to the media.
6. The establishment of a sanitation monitoring team to inspect the environment regularly and prosecute defaulters accordingly.

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