Educational
Administration
Theory and Practice

Choosing A Site For The Waste Dump For The City Of Baghdad Using Geographic Information Systems (GIS)

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ARTICLE INFO	ABSTRACT
	The city of Baghdad faces great challenges in solid waste management, as waste accumulates in residential and public areas, posing a threat to public health and the environment. Geographic Information Systems (GIS) can be used to assist authorities in managing solid waste by analyzing spatial data and determining the best locations for waste disposal sites. This includes building a mapping model to visualize and analyze spatial data using various GIS tools, and identify key selection factors for selecting the best waste disposal sites, such as distance from residential and public areas, water resources, and the environment. The end results can provide appropriate recommendations and solutions to improve solid waste management in Baghdad. **Keyword:** GIS, Relative importance index, Political criteria, Environment criteria, Economic, Contextual and importance of the study

Introduction

The problem of waste has received widespread attention from developed countries, and they have sought to prepare strategic plans in accordance with development, technology, growth, expansion and other developments occurring in the world. Therefore, you notice that most developing countries have limited interests in the field of unions, including Iraq, which is keeping pace with this development by taking measures. Actual at the level of organizational and technical aspects, which has led to a large number of negative impacts on the health of citizens and on the environmental field, with the technological development of the computer and the major role it plays in facilitating the use of statistical software to solve geographical problems according to the scientific method of collecting, compiling, processing, analyzing data and presenting the results. As geographical applied methods, the development in geographic information systems (GIS) technologies has made it easier for geographers to use spatial statistical analysis tools and spatial statistical modeling to reach geographical generalizations in the form of models of spatial variation patterns of geographical phenomena. Geographic Information Systems (GIS) will be used to map and analyze rich data related to locations on the Earth's surface. GIS and analysis tools are used to visualize, analyze and understand the vast amounts of data that are collected to support informed decision making at every step of the project. Therefore, because these systems have begun to take an important position in environmental, economic and social development, it is necessary to study them and understand their objectives.

What is the search problem?
The deterioration in the process of selecting sites designated for sanitary landfill and its serious environmental impacts in turn affect the lives of citizens in Iraq, as the current landfill violates international and Iraqi standards for establishing waste libraries, as Iraq produces approximately 30 thousand tons of solid waste daily . However, it lacks qualified infrastructure to deal with this amount of waste and dispose of it in an appropriate manner that ensures that there are no negative effects on the environment and the health of the population, so most of the waste is disposed of in unregulated landfills. This study aims to determine the foundations of proper planning for sanitary waste landfills, and to attempt to suggest specific places as suitable sites for establishing waste landfills based on a set of conditions and standards. Thus, this research attempts to answer the following questions:What is the reality of the current waste dumps in Baghdad

1- What are the conditions and standards that can be taken into consideration to choose appropriate and healthy sites for waste dumps
2- What are the appropriate and safe places for waste dumps that reduce damage to the natural, human and economic aspects in the study area
3- GIS techniques be used to choose suitable places for waste dumps?

research importance

Geography has come to take from statistics, just as it takes from the rest of the sciences, which helps geographical work to reach results that help in decision-making processes in applied aspects. From this, the importance of this research is evident, as quantitative analysis using computer techniques has become a feature of the era in modern scientific research and learning to use computers. The application of software is necessary for every researcher at the present time and for all branches of natural and human geography, as numbers are the basis for research in these branches. Without them, the scientific researcher remains far behind in keeping pace with developments in modern research methods. These trends, which began with the success of communications technology, the information and software revolution, and the increasing demand in recent years for advanced training in statistical methods software in geography and conducting advanced analysis processes, have formed.

research aims

aims to do the following:
1. Identify the administrative level in dealing with waste and managing it in Baghdad.
2. Know the conditions and standards used in planning the best sanitary landfill sites.
3. Planning landfills and choosing appropriate sites whose negative impacts on the environment and humans are at the lowest levels.
4. Reaching a set of results, and presenting proposals and recommendations that benefit researchers in this field .

Research Methodology

The researcher used the descriptive analytical approach, which is based on collecting a sufficient amount of information and data related to geographic information systems (GIS) and how to use them in selecting appropriate union dumpsites by reviewing the various confiscations, represented by books, studies, and research.

Geographic Information Systems (GIS)

The concept of geographic information systems GIS
System has become one of the necessary means for planning and managing natural resources. These systems include collecting information, entering it and storing it in geographic databases, which are large and huge depending on the size of this data, as well as analyzing the data and performing models for it, and the possibility of obtaining visual and printed images of the results. These can be obtained. Systems in both personal computers and mainframes and geographic information systems (GIS) are the new language of technology that will quickly become an essential tool for analyzing and clearly communicating knowledge about our world. (Maysoon Taha Mahmoud 2008) Geographic information systems have entered various fields, including urban planning, which is defined as the spatial distribution of urban topics, objectives, functions, facilities, and activities. The definition appears to include all uses of geographic information systems. As explained before, geographic information systems are considered extremely important in solving many problems. Cities' problems, whether at the regional or local level. (Dr.. Diaa Abdel Mohsen Muhammad2016)
There is no definition for geographic information systems, as its definition depends on the specialist, whether he is a user, program designer, data collector, or other. Among these definitions, we mention data in a database management system, graphics in special software, and then merging the graphic and graphical sections according to special programs(Ali Abbas Al-Azzawi 2022.)
It is an organized procedure and process aimed at collecting, documenting, processing and retrieving information in order to secure the needs of the largest possible number of researchers, decision makers and other beneficiaries and the geographic information system from Another starting point is a mechanism and organized procedures that allow the collection, classification, and sorting of data (Data) and then processing it often within a computer system and transforming it into information (Information) that a person can retrieve when needed to be able to accomplish work, make a decision , or perform a function that benefits the movement of society through the knowledge that he obtains. It contains information retrieved from the system(Maysoon Taha Mahmoud Al-Saadi 2008 .
It can be said that Geographic Information Systems (GIS) is a computer technology used to store, analyze, and display geographic and spatial data, which includes information about the locations, places, areas, and geographical characteristics of anything that can be geographically identified, such as roads, buildings, rivers, natural reserves, farms, lands, and neighborhoods. A geographic information system usually consists of a

spatial database containing data for various locations, in addition to a program that allows users to create, modify, and delete data, as well as display the data geographically through maps and other graphs. This technology allows the use of geographic data more effectively and accurately in many areas. From areas such as public administration, urban planning, economic development, environment, health, tourism, transportation, mining, agriculture, forestry, disaster control, etc.

There is a misunderstanding of the tasks performed by these systems, as many view these systems as systems dedicated only to producing maps and managing data. It is true that geographic information systems perform these tasks, but they also perform other tasks that distinguish them from other programs. These tasks are analyzing spatial and tabular data with Analysis Attribute Data, spatial inquiry about the data, in addition to importing spatial and non-spatial data from other programs and websites, and drawing maps.) (Ahmed AlKubaisi, spatial intelligence and geographic techniques. 1st edition. Dar Al-Yazouri for Publishing and Distribution. Oman 2020. p. 96)

As for GIS users, they can be placed in two main categories

A. Academics: This category includes geographers, engineers, geologists, economists, cartographers, planners, planners, and others .

B. institutions and companies include the military, health, environment, local government, water and energy

Geographic information systems applications

Geographic Information System GIS is used in many applications, including:

1 - Urban and rural planning: The geographic information system is used in analyzing and planning cities, villages, and rural areas, including analyzing geographical factors affecting urban planning such as water, topography, topography, traffic and urban movement, analyzing population distribution, public, commercial and industrial services, planning urban and agricultural growth, and managing urban plans and green areas. And many other challenges.

2 - Transportation: GIS is used in analyzing and planning transportation networks, public transportation, planning travel routes, intelligent transportation systems, traffic analysis, public transportation, accident prediction, reducing traffic congestion, and planning new locations for roads, bridges, tunnels, etc.

3 - Environment and Nature The geographic information system is used to analyze and monitor geographic phenomena related to the environment and nature, such as climate change, natural disasters, ecosystem analysis, natural resource management, identifying areas sensitive to pollution, monitoring air, water and soil quality, environmental preservation, sustainable development, and others.

4 - Health: The geographic information system is used to analyze geographic data related to health, diseases, hospitals, and health centers, plan health sites, analyze health risks, monitor widespread diseases, provide health services, manage epidemics and infectious diseases, administer vaccinations and medications, plan health emergencies, and others.

5 - Agriculture and forestry: The geographic information system is used to analyze geographical data related to agriculture and forestry, plan agricultural sites, monitor agricultural lands, determine suitable areas for growing specific crops, evaluate soil and water quality, plan irrigation, reduce desertification and land erosion, manage forests, monitor changes in biological diversity, identify places sensitive to fires, and others.

Energy and Infrastructure: GIS is used to analyze geographic data related to energy and infrastructure, plan renewable energy sites, monitor and manage electrical networks, plan and build urban and rural infrastructure, analyze the impact of urban projects on the environment and neighboring areas, estimate energy demand, waste management, and others.(Yara Taamra. 2017)

There are many other areas in which GIS can be used, including:

1- Government Administration GIS can be used to improve local, regional, and national government administration, such as city planning, reducing pollution, improving the transportation system, managing waste, water and sanitation, identifying sites sensitive to natural disasters, and analyzing the impact of climate change on communities.

2- Environment: Geographic information systems can be used to analyze geographic data related to the environment and identify regions. Sensitive to pollution, monitoring geographical patterns of climate and environmental changes, analyzing ecosystems and the movement of animals and plants, identifying suitable sites for establishing environmental protection areas, and assessing the environmental impact of industrial, agricultural and other projects.

3- Security and defence: Geographic information systems can be used to analyze geographic data related to security and defense, identify areas sensitive to security, crime, and terrorism, plan and manage civil protection, determine appropriate locations for establishing security, military, police, and air surveillance centers, identify areas sensitive to crises and natural disasters, and analyze geographic data for the armed forces, intelligence, and others.

4- Tourism and culture: Geographic information systems can be used to analyze geographical data related to tourism and identify archaeological, tourist and cultural sites.

Economy and Business: GIS can be used to analyze geographic data related to the economy and business, identify new markets and investment opportunities, analyze the labor market and labor distribution, analyze consumption and spending patterns, international trade, transportation, logistics, warehousing, and others.(Dr.. Khalaf Hussein Ali Al-Dulaimi 2019)

Obstacles to the application of geographic information systems

Although geographic information systems provide many advantages and benefits, there are some obstacles that may face the process of applying them, and these obstacles include :

1- Cost The price of software, hardware, training and development can be prohibitive, making it less expensive for individuals and SMEs.
2- Experience and Training Implementing GIS requires experience using specialized software and hardware, which can be difficult and complex for new users, requiring ongoing training and education.
3- Data Quality: Lack of quality data used in GIS application may affect the accuracy and effectiveness of analyzes and forecasts.
4- Standards and contributions: GIS may have difficulties using uniform standards and authentic contributions from different users, which can affect the quality and accuracy of data and analyses.
5- Privacy and Security Necessary precautions must be taken to maintain the confidentiality and security of data that may be subject to hacking or unauthorized access.
6- Legal Restrictions: Legal restrictions may be imposed on the use of some exposed or sensitive data, requiring that the correct legal procedures be followed to obtain and use this data in a correct and responsible manner. (2)

Stages of applying geographic information systems

The stages of applying Geographic Information Systems (GIS) can be summarized as follows:

1 - Collecting geographic data: Most decisions depend on quantitative and descriptive geographic information at a rate of up to (80%). Therefore, geographic information systems have become one of the important tools in spatial and statistical analysis. There are several ways to obtain information, including what is known as primary information, which can be collected using land surveying. Aerial and space photography, the Global Positioning System (GPS), including what is known as secondary information, which can be obtained by a scanner or automatic line tracking number plate.

Understanding and using GIS requires knowledge of the quantitative and descriptive spatial data that make up the strength of this system, as quantitative spatial data (DATA SPATIAL) includes information about the location and shape of the geographical phenomenon, and storing that data in the form of coordinates. It can also include other information about the relationships of those features to each other, such as neighborhood and connectivity relationships. While metadata includes attributes and descriptions of the characteristics associated with that phenomenon and is stored in separate tables. GIS is characterized by its high ability to combine quantitative and descriptive data together. (Mahboub bin Hamouda. 2021).

The data used to build GIS models consists of:

• Spatial data: It is in the form of points, lines, and areas.
• Tabular data: Information added to tabular map data to describe a map feature.
• Statistical data: It consists of graphical forms of columns, circles, and lines that express the values of the elements that were measured.
• Cartographic pictorial data: Using images to build map image data that includes various elements, satellite and aerial images, and photographic survey data, which are converted from paper to digital.
• Environmental information: which includes the natural characteristics of the region, human activity, economic activity, urban and biological characteristics, and environmental pollution in the region .
• Cadastral and engineering information: The system of geodesic, geographic, and mathematical coordinates is one of the important elements of GIS to facilitate dealing with the real locations of information, the process of change from one system to another, and familiarity with the changes that occur in the form of geographical phenomena according to the change in the coordinate system, as there are two types of coordinates, which are planar and spherical.

GIS software :

GIS programs are programs that allow users to create, manage, analyze, and display spatial (geographic) data, and provide many of the tools necessary to perform geographic analysis and interact with maps and spatial data in an easy and flexible manner.(Ahmed Saleh, 2007).

There are many programs used in geographic information systems, but these programs are divided according to the way they work, which are:

1- Programs that work using vector method 2- rograms that work using the Raster method .

3- Programs work both ways
4- Programs that only convert between the two methods

Devices (computer hardware):
Geographic Information Systems (GIS) require some special computing devices to carry out their tasks effectively. These devices include:
- Personal computer: The personal computer is used to run GIS programs and process geographical data, and it must have specifications that allow the programs to run and perform analyzes smoothly, such as processor speed, memory size, and screen capacity.
- Central Processing Unit (CPU): The CPU is responsible for running programs and performing geographic analyses, and it must be powerful and fast to run heavy programs.
- Graphical processing unit: (GPU) The graphic processing unit is used to display and analyze geographical maps . It is powerful and fast to ensure smooth display of data.
- Hard Disk : The hard disk is used to store huge geographical data, and its capacity must be sufficient to store the data completely.
- External storage unit External storage units are used to save geographic data and exchange it between different computers. Wide and multi-coloured.
- Screen The screen is used to display maps and geographic images, and should: display data better.
- Scanner: A scanner is used to convert maps into digital formats that can be analyzed in GIS programs.
- Printer A printer is used to print geographic maps and reports that are created in GIS programs
- GPS devices are used to determine geographical locations with high accuracy, and are used in many field applications that require precise location, such as aerial photography, mapping, etc.
- Digital Earth scanning devices are used to create three-dimensional models of the Earth, through the use of laser technology .

The reality of waste dumps in Baghdad
Waste dumps in Baghdad are among the biggest environmental challenges facing the city, as waste is disposed of in random dumps in different areas of the city, and the waste is not treated properly and these dumps cause air, soil and groundwater pollution, and pose a threat to public health.(Dr. Salah Mahdi Abbas, 2012) The municipal directorates in Iraq suffer from major and important problems in the issue of collecting, lifting and transporting waste for many reasons, some of which are related to human, financial, material and other resources. The phenomenon of bacterial contamination and the accumulation of various types of waste resulting from humanitarian and medical activities in Iraq is considered a dangerous phenomenon due to its negative effects on Society and public health of individuals. The matter becomes more complicated when awareness of the seriousness of pollution is insufficient and there is a weakness in properly implementing systems for managing this waste. (Sawsan Shaker Majeed. 2020)
The city of Baghdad suffers from a lack of infrastructure necessary to properly manage waste, and there is no clear strategy for waste disposal, and garbage is spread in the streets and alleys. The lack of appropriate waste management solutions leads to the accumulation of insects, unpleasant odors, and the spread of diseases. In addition, Baghdad faces other challenges related to waste management, such as the lack of environmental awareness among the population, lack of commitment to safe waste disposal methods, and the delay in government projects to build waste treatment plants and modern landfills. , which requires large investments, and random waste dumps in Baghdad cause the destruction of natural areas and agricultural lands, affect the health of individuals and harm groundwater, lakes and rivers in the region. In addition, these landfills affect air quality and increase greenhouse gas emissions, contributing to global climate change.

Geographic information systems analysis in choosing the best landfill
1. The reality of applying geographic information systems in Baghdad
Geographic Information Systems (GIS) can be used to determine the best location for a landfill in the city of Baghdad, by analyzing the various factors that must be taken into consideration, such as the distance from residential areas and public facilities, the quality of soil and land, the flow of groundwater and rivers, and the extent of the site's impact on the environment. GIS can also be used to analyze the geographical characteristics of different areas in Baghdad, and to identify areas that meet the environmental and geographical requirements necessary to establish a landfill. For example, GIS can be used to identify areas far from residential areas and public facilities, that contain good soil and are not affected by sewerage flow. Underground or rivers, which contain a strong infrastructure for transportation, storage, and treatment. GIS can also be used to determine areas where the productive capacity of a landfill is available, which can be used to create facilities to generate energy from waste, such as thermal power plants. (millimeter. Marwa Salem Muhammad, 2020)
In general, a site must be chosen. Waste Office based on a comprehensive analysis of geographical and environmental factors. Economic, and strict standards must be applied to reduce the environmental and health impact of the landfill, after analyzing the factors. Using geographic information systems, a list of potential sites for a landfill in Baghdad can be drawn up, and then each site can be evaluated individually based on health, environmental, and economic criteria. GIS can be used to analyze the extent of the office's potential impact on

its surrounding areas, determine the safe distance between the office and residential areas and public facilities, and then determine the space needed to establish the office, and determine the time period required to use the landfill. (Ali Karim Shaish and Mustafa Naim Hamoudi. 2010.)

GIS can also be used to analyze the logistical needs of the office, such as the distance from waste collection sites and production areas, and determine appropriate logistical lines for transporting waste from its sources to the office. GIS can also be used to manage the landfill effectively such as determining locations for facilities needed for various waste treatment and storage and determining optimal paths for landscaping. Unloading trucks loaded with waste. In general, geographic information systems can be used to analyze the various factors and criteria related to the location of the waste landfill, and determine the best location based on a comprehensive and integrated analysis of geographical, health, environmental and economic factors.

Table No 1,Shows the percentages according to the sources of solid waste in the city of Baghdad)

% percentage	Solid waste sources
65-55	Household waste
10-5	Industrial waste
15-10	Commercial waste
5-3	Institutional waste
7-4	Medical waste
5-2	Municipal waste services
40-20	Waste rubble
5-1	Other

Source: M. Marwa Salem Muhammad, previous source, 359 pages

1. .The use of geographic information systems in solid waste management
The problem of solid waste is considered at the forefront of the internal problems in urban areas, due to its direct impact on the quality of human life and the cultural appearance, and this has serious repercussions on comprehensive development. The quantities of solid waste have become enormous and their quantities are increasing directly with the increase in the population, while their content of harmful substances that It is difficult to identify or limit its generation. Solid waste is considered a national wealth that can generate a large return if it is managed correctly because it can be recycled and most of its components used. Random disposal wastes materials that may be of economic value, in addition to the accompanying negative effects on the .environment and health

(Geographic information systemsGIS ,can be used in solid waste management in several different ways) including:

1. GIS can be used to determine suitable locations for establishing solid waste landfills, by analyzing various factors such as the geographical nature of the area, soil, climate, topography, and distance from residential areas and public facilities. It is also possible to determine the appropriate area and depth of excavation and determine the optimal methods for waste disposal

2. Determining solid waste collection sitesGIS can be used to effectively determine solid waste collection sites in appropriate locations, by analyzing various factors such as population density, vehicle traffic.pattern, and the distance required to collect waste from different sources

3. Determining shipping and transportation routesGIS can be used to determine the optimal routes for, transporting solid waste from collection sites to disposal sites, by analyzing various factors such as distance. access to main roads, traffic congestion, and other factors

4. Management of landfills and sorting stationsGIS can be used to manage landfills and sorting stations effectively, by analyzing various factors such as waste distribution, classification, quantity, and shipping and transportation routes. This information can be used to plan facilities, control waste removal and disposal operations, and control the pollution resulting from them. As well as to control consumption, cost, and utilize resources effectively.

5. Environmental Impact AssessmentGIS can be used to evaluate the environmental impact of solid waste management operations, by analyzing various factors such as air, water, soil, wildlife and human pollution, and this information can be used to make the necessary decisions to improve the environmental performance of the system

Awareness and Education GIS can be used to raise awareness and educate about solid waste management and its   importance effectively. By analyzing various factors such as population density, social and cultural composition, and geographical distribution of public facilities, this information can be used to develop awareness and educational. campaigns for the public and the local community ([1] ,Tariq Sharifi and Kawthar Othman 2018)

In general, geographic information systems can be used to manage solid waste in an effective and integrated manner, by analyzing various factors and identifying optimal solutions to improve environmental performance and sustainability and reduce the pollution resulting from them.

2. Stages of building the cartographic model and choosing the best sites for waste dumps

The cartographic model is best defined as a set of maps in the form of layers thatshare a single cartographic framework that relies on a spatial reference known as coordinates. Therefore, the process of determining the locations of waste dumps requires a large number of layers, and these layers require many analytical operations before the process. Match them

and extract the best locations (1 ,Durgham Abdel Latif Shtayyeh and Ahmed Raafat Ghadba2012).

The following are the stages of creating a cartographic model:

A.   Defining and formulating land evaluation criteria. Many criteria were adopted in the planning process, through the available layers and database that were provided to theGIS system The . system then identifies suitable sites for establishing waste dumps, especially after excluding unsuitable areas such as military areas and natural reserves. Each criterion will be given a specific rank according to its importance. The sensitive and most important criteria that negatively affect the ,environment and humans in the event of a waste dump being built nearby will receive a lower rank and the less important criteria or those that do not pose a direct threat to the environment and the residents of the area will receive a higher rank on the grounds that they are more appropriate. The criteria that will be included in the comparison process can be summarized in Table No.) 2(

Table No.)2(shows the criteria used in selecting the best sanitary waste landfill sites

the scale	Sub-criterion	Standard
Barren lands, salty and rocky areas, and unsuitable for agriculture are considered excellent sites for a landfill, while sites with dense agriculture and greenery and planned for development purposes are .considered bad sites	Land uses	Social economic and standards
A distance of no less than 500 metres	The distance between the landfill and the main highways	
It is more than 1,500 meters away from existing and planned residential areas	Far from residential areas	
The shorter the distance from the generation center, the more reasonable the distance is and serves areas of population concentration, and the lower the costs of transporting and managing waste accordingly	Distance from sources of waste generation	
Prefers low agricultural value lands	Land's productive capacity	
The soil must be of low permeability	the soil	Geological and geomorphological considerations
.is considered an ideal slope and does not exceed 25% 5%	Topography and slope ratio	
The distance between the waste dump and the nearest water well must be no less than 360 metres	Exploited wells	Environmental considerations
A distance of no less than 360 metres	Distance from springs	
A distance of no less than 100 metres	Stay away from valley streams and torrents	
Ponds with lower stock and deeper water levels are preferred	Ground basins	
Prefer areas where landfills can be blocked from view and slopes that are located opposite the direction of the wind in relation to .populated areas	Direction of mountain slopes and prevailing winds	Climatic standards

.Source: Dargham Ab Latif Shtayeh and Ahmed Lafat Ghadba. Previous source, p. 10

B. Data collection
Collecting data is considered the first and most basic in building any geographical information system as various data are collected related to the different regions in Baghdad, including the current locations of waste dumps, vacant areas available for use, potential environmental risks, and any other details .related to the sites of the dumps

The data collected at this stage is used to analyze and evaluate different sites, using various available factors such as distance from residential areas, places designated for agriculture, environmentally .sensitive areas, and other factors related to potential sites

C. Create maps

This procedure includes creating detailed maps of Baghdad areas, entering the analyzed and evaluated data into the geographical information system, and ensuring the accuracy and consistency .of the data entered into the system

D. Map analysis

At this stage, the created maps are analyzed to determine the most suitable places for establishing landfills based on specified criteria, such as distance from residential areas, environmental availability, cost and potential development. The analysis tools available in the Geographic Information System are used. They include a wide range of tools that can be used to analyze maps and determine the best locations to create landfills for waste in Baghdad. These tools can be divided
:into several categories. Such as
• Distance analysis tools
These tools allow users to calculate the distances between different points on the map and analyze them in detail, which helps determine the most suitable locations for establishing .union libraries in residential areas, sensitive areas, and agricultural areas
• Nature Analysis Tools
These tools allow users to analyze potential environmental risks and verify the aailability of a suitable environment for creating landfills. These tools include processing satellite
.images and geological and environmental maps
• Economic analysis tools
These tools allow users to analyze the potential costs and benefits of constructing landfills in different locations. These tools include analyzing costs related to transportation and disposal of waste and analyzing the expected total cost of constructing landfills.
• Statistical analysis tools
These tools allow users to analyze statistical data related to different regions in Baghdad These tools include analysis of population rates, urban development, and analysis of statistical factors.
• Concentration analysis tools
• These tools allow users to analyze current concentrations of waste in Baghdad and identify locations that should be given special attention to establish waste libraries .according to minimum permissible environmental concentrations
• Ground analysis tools
These tools allow users to analyze land and terrain information and estimate slope hollowing, and rainfall, and this data can be used to identify suitable locations for landfill construction, while identifying locations that could be vulnerable to landslides and fractures.
• Modeling analysis tools
These tools allow the creation of realistic models that simulate various events and processes associated with waste management such as forecasts of waste movement, noise .levels, emissions and their impact on waste. Environment and public health.
• Network analysis tools
These tools allow users to analyze large transportation networks and identify suitable sites ,for landfill construction, including public transportation sites, major truck and car routes and parking lots. Using these tools, users can build an integrated cartographic model that identifies the best landfill construction sites in Baghdad according to the specified .standards. These tools help analyze data more accurately and save time

After using various analysis tools and obtaining results, it is possible to begin building the cartographic model that reflects the best locations for union dumps in Baghdad. Building the cartographic model consists of the following steps:
Upload spatial data: You must first upload spatial data related to the city, such as maps, transportation data .terrain, green spaces, agricultural lands, residential neighborhoods, public facilities, etc
Create the necessary layers : You must create the necessary layers that will be used in the model, such as the .solid waste layer, the potential landfill sites layer, the roads layer, the residential neighborhoods layer, etc
Data analysis : Data must be analyzed using various analysis tools, such as geographic analysis, network analysis, multi-factor analysis, and others.

Results and recommendations Conclusions

(After performing spatial analysis using geographic information systemsGIS : the following conclusions were obtained ,)

1. Five potential sites were identified to establish union dumpsites in different areas of the city of Baghdad: Al-Ridwaniyah, Al-Tarmiyah, Al-Doura Al-Ghazaliyya, and Al-Shuala

2. The Al-Radwaniyah area was identified as the best location to establish the waste office, based on various local factors that were considered in the analysis process, which included distance from residential .areas, schools, hospitals, rivers, lakes, etc

3. These results were based on the factors identified and data available at the time of the study and cannot .be relied upon in the future due to possible changes in conditions and surrounding environment

4. These results can be used in the environmental planning process for the city of Baghdad and in making .future decisions related to the construction and management of landfills

5. Various factors and spatial analysis must be taken into account in choosing a landfill site, including the natural, demographic, economic and social environment, legislation and government directions related to waste .management

6. This cartographic model can be updated using recent data and analyzed again to determine the best .landfill location after the expiration of these results

7. GIS can also be used in solid waste management in general, including effective planning for waste .collection and management, analyzing waste data, and developing effective disposal strategies

8. The use of geographic information systems in solid waste management is considered an effective method for spatial planning, resource and environmental management, and it can be used in many other fields related to urban and urban planning and natural resource management.

Recommendations

Based on the conducted study, there are several recommendations that can be made regarding the use of information systems to optimize the location of waste landfills, including:

1. Update geographic data regularly to improve the accuracy of results and keep pace with developments in the city.

2. Expanding the scope of the study to include other aspects such as social and economic aspects to determine the impacts of the landfill on the society.

3. Incorporate land, water and air analyzes into the study to ensure that the proposed landfill does not cause environmental pollution.

4. Conduct construction, operation, maintenance, and waste disposal cost studies to determine the actual costs of constructing a landfill.

5. Employing specialized teams in the field of geographic information systems and urban planning to develop the cartographic model and analyze data.

6. Increasing public awareness about the importance of managing solid waste and disposing of it in correct and safe ways.

7. Establish solid waste management centers to analyze data and make informed decisions on waste management.

8. Supporting government efforts and specialized institutions in improving solid waste management and establishing safe landfills in Iraq.

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