

1-1 General

Source reduction, recycling and waste transformation methods are widely used to manage solid waste, however in all of these methods there is always residual matter even after the recovery process or disposal. The necessity of getting rid of these waste yields in an economic approach which is called as landfilling. [Tecobanoglous, G., Kreith, F., 2002].

Landfill siting is an extremely difficult task to accomplish because the site selection process depends on different factors and regulations. It is becoming increasingly difficult due to growing environmental awareness, decreased government and municipal funding and extreme political and social opposition. The increasing population densities, public health concerns, and less land available for landfill construction are also difficulties to overcome [Kao, J.J., and Lin, H., 1996].

Environmental factors are very important because the landfill may affect the surrounding biophysical environment and the ecology of the area [Siddiqui, M.Z., Everett, J.W. and Vieux, B.E., 1996].

In this study, candidate sites for an appropriate landfill area of Khartoum had been determined using the integration of Geographic Information Systems (GIS) and multicriteria decision analysis (MCDA). Utilizing these methodologies prompting to incorporated ecological administration are important to permit thought of all segments and procedures in condition; their spatial, temporal, and human dimensions; their interaction and correlation, coupled with social, economical, political, and legal impacts. GIS has matured into a powerful tool that can integrate driven types of spatial data and perform a variety of spatial analysis.

This evolution had been driven by significant advances in computer technology and the availability and quantity of data.

GIS and environmental models function with a broad spectrum of geospatial data that had been used for diverse applications and spatial analyses at different scales. Data had been collected through observation, measurement, and inference. The examination and association of information into a helpful shape delivered data, which then empowers fitting investigation and demonstrating.

For this purpose, input digital map layers including settlement (urban center, villages, and industrial areas), main roads, airports, wetlands, digital elevation model, land use (camps, palace, water and waste water treatment plants, agricultural zone, gardens and buildings) and surface water (streams and main irrigation channels) had been prepared and simple additive weighting method had been implemented to a geographical information system. The digital map prepared according to environmental criteria of landfill sites selection stated by World Bank and published researches.

One of the main criteria obtained in this study is to get right decision to choose the landfill area sufficient for at least 5 years of Municipal Solid Waste (MSW) volume. This criterion was a part of actual criteria which compared with digital map resulted from simple additive weight method in decision making analysis. Therefore, to determine, MSW generation rate per capita predicted for year 2014 and extrapolated to 2018. Discard and compacted generation waste volume evaluated for each year of estimated duration. This volume could be decreased if a well technique had been used for exchange are assembled, taken care of and remanufactured that called reused or another portray as reusing. Along these lines MSW grouped in six classes: organics, papers, plastics, glass, metals, and

other inorganic waste. Household waste physical composition survey was done for the selected year 2014 to find Khartoum MSW percentage which has been adopted in determination of waste volume reduction.

This study concentrated on sanitary landfill used for MSW classified in chapter two. Any other waste type such as hazardous wastes that produced from industrial and medical processes or other sources are out of scope.

1-2 Statement of problem

Khartoum state is considered one of the areas that suffer from the problem of solid waste management and disposed of properly take into account the principles and standards of public health and safety; and in light of increasing production of waste, which requires search for suitable solutions to this issue.

The problem of the waste dumps existing in Khartoum state is great challenge where the randomly disposal of waste constitutes one of the main sources of environment pollution. In Khartoum, the waste is still being disposed of by traditional ways such as burning and uncovered dunghills. These bad and old ways result in so many environmental problems and distort the city scenes. They also become suitable home for rats that invade the houses, causing various diseases and so many damages.

Moreover, waste burning results in smoke and bad smell emission that threatens human, animal and plant lives, making it difficult for the people to live in the area.

For example, Abu Walidat dunghill which is 5.1 km² and about 40 km from Khartoum center does not conform to the international standards and causes environmental impacts because there is no system for waste juicer collection.

The study comes in order to determine the foundations of proper planning for sanitary landfills, and put solutions to many of the problems related to this mandate, through the use of GIS technology in the planning and choose the best.

1-3 Research questions and hypothesis

It expects this study to answer some questions on the subject in question in order to be a comprehensive study of the subject as a whole does not suffer from any ambiguity and these questions are as follows:

1. Are the existing landfill sites suitable?
2. Are there standards and criteria can be considered for the choice of fitting wellbeing destinations to landfills?
3. What are the appropriate places and safe for landfills, which reduces the damage on the aspects of nature and the human and economic study of the area?
4. How can the use of GIS in planning and determining the appropriate places and safe health landfill?

1-4 Research objective

1-4-1 General objective :

To evaluate solid waste in Khartoum state and selection of landfills sites using GIS technique.

1-4-2 Specific objectives :

1. To develop methodology involving both Geographic information system(GIS) and Multi criteria Decision Analysis (MCDA) to apply it in

- an area for selecting Municipal Solid waste (MSW) landfill sites of Khartoum state in lesser environmental impact and evaluate the old landfills.
2. The prediction of MSW composition and generation rate to determine the required waste volume which needs to be disposed.
 3. The estimation of MSW volume reduction if proper recycling strategies used.

1-5 Thesis layout and scope

The research work had been covered in five chapters:

Chapter One: Gives a general overview on research strategy study problem and objectives.

Chapter Two: Deals with MSW management, MSW classification, landfilling and review of landfill criteria.

Chapter Three: Methodology of Khartoum MSW physical composition, theory of Multi criteria decision analysis

Chapter Four: Results and Discussion.

Finally **Chapter Five:** Includes conclusions and recommendations.