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Environmental Impact Assessment of a Proposed for Solid Waste Management Facility in Al-Wihda Sub District, Baghdad Governorate

Haider Kareem Ali Alobaidy

Higher Diploma of Environmental Impact Assessment Engineering Sciences, Iraq

Abstract: ***Over the past decades, uncontrolled population growth and rapid urbanization and industrialization have resulted in environmental problems. One of the most important problems is inadequate solid waste management. Nowadays, increasing public awareness of the environment compels local authorities to define and to adopt new solutions for waste management. Although there are some efforts to reduce and recover the waste, disposal in landfills is still the most common method for waste destination. Therefore, the recycle facility should be selected carefully by considering both regulations and constraints on other sources. In this study, candidate site for an appropriate solid waste facility area in Al-Wihda sub district in Baghdad city is determined by using The GPS coordinates (Latitude 33˚ 07.674N Longitude 44˚42.420 E), according to the EIA legal (Category B) in article 24, 48 for landfill and solid waste management facility number (3) 2011 based on law number (27) 2009. The selected site serves a population of Al-Madain districts (461107 capita), and covered area about 53.64 km^2. Area method has been choosing in the proposed design because the level of groundwater in this reign is so high, also the amount of predict solid waste has been calculated for next ten years 2371174.7 ton. A sample of solid waste was taken to identify the quality of the waste shows that it contents (steel, aluminum, plastic, glass, paper, carton and temper) which can be recycled. A set of experimental tests have been done to evaluate and monitor the environmental impact of pollutant on the surrounding area of the proposed project at the present and future time. From which was mentioned above, the selected location is suitable for constriction the solid waste facility according to the EIA legal (Category B) in article 24, 48 for landfill and solid waste management facility number (3) 2011 based on law number (27) 2009, therefore we recommend implementing this necessary project.***

Keywords: Solid Waste Management, Sanitary Landfill, Baghdad, Al-Wihda Sub District

1. Introduction

Environmental Impact Assessment (EIA) is a process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant impacts of development proposals prior to major decisions being taken and commitments made. These studies integrate the environmental concerns of developmental activities into the processes of decision-making [1].

Sustainable development is built on three basic premises i.e., economic growth, ecological, environmental balance and social progress. Economic growth achieved in a way that does not consider the environmental concerns, will not be sustainable in the end. Therefore, sustainable development needs careful integration of environmental, economic, and social needs in order to achieve both an increased standard of living in short term, and a net gain or equilibrium among human, natural, and economic resources to support future generations in the long term. It is necessary to understand the links between environment and development in order to make choices for development that will be economically efficient, socially equitable and responsible, as well as environmentally sound.

Solid waste includes waste from households, non-hazardous solid waste from industrial, commercial and institutional establishments (excluding bio-medical waste), market waste, yard waste, agricultural wastes and street sweepings. Solid waste management encompasses the functions of collection, transfer and transportation, processing and recycling, and disposal of solid waste. Safe and cost-effective management of solid waste is a significant environmental challenge for modern society. Inadequately managed waste disposal has the potential to affect the health and environment. Ideally, solid waste management should incorporate the principles of waste minimization, recycling, resource recovery as well as an integrated processing and disposal facility, leading to effective service delivery in a sustainable manner.

2. Problem Statement

Problems in waste management have become more and more complex during recent decades. The increasing volumes of waste produced and social environmental consciousness present prominent drivers for environmental managers towards the achievement of a sustainable waste management scheme. Depends up on population, amount of solid waste produce from Al-Madain district it has been found that the sanitary landfall station in this area become very important, so a certain area was providing for this station at Al-Wihda sub district.

3. Objectives of EIA Study

Effective waste management is a high priority in Al-Wihda sub district and the siting, design and management of landfills play an integral role in effective waste management. The main objectives of this study are to conserve resources through effective avoidance and resource recovery. Landfill has an important role to play as part of the transition required to achieve sustainable resource recovery and waste management. The role for landfill primarily involves accepting those residual materials that are unable to be avoided, reduced, reused,

recycled or recovered. Finally, the purpose is to provide a consistent and environmentally responsible approach to managing landfills in Al-Wihda sub districts. This project should be used for the planning of environmental approvals.

4. Type of Landfill Facility

Two methods of landfilling solid wastes are used in landfilling, the area and trench methods shown in Figure 1. Consideration should be given to the factors affecting the siting and design of landfill facilities before the method of waste disposal is finalized.

A. Area method: The area method its variations, involve above ground waste disposal. The area method is suitable for use in a range of terrains and situations but is generally best suited for flat to gently sloping areas where design and operation will be simplified. The area method is also well suited to situations where high rainfall or high groundwater conditions present problems for use of trenches.

B. Trench method: The trench method involves burying waste below ground in excavated trenches. Trenches have the advantage that the soil excavated in forming the trench can be used for covering the waste disposed of in the trench. However, in wet areas high groundwater conditions may make the use of trenches impractical. Trenches must be oriented perpendicular to the prevailing wind to help minimize blowing litter.

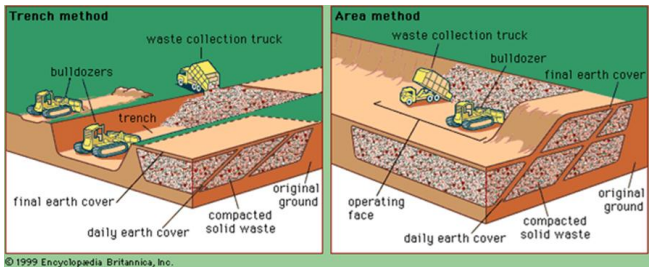

Figure 1: Types of landfill facility

Area method will be chosen because the level of groundwater in this reign is so high and there is a wide area for this type of method.

5. Literature Review

Solid waste management (SWM) has become an issue of increasing global concern as urban populations continue to rise and consumption patterns change. The health and environmental implications associated with SWM are mounting in urgency, particularly in the context of developing countries. While systems analyses largely targeting well-defined, engineered systems have been used to help SWM agencies in industrialized countries since the 1960s, collection and removal dominate the SWM sector in developing countries. This review contrasts the history and current paradigms of SWM practices and policies in industrialized countries with the current challenges and complexities faced in developing country SWM. In industrialized countries, public health, environment, resource scarcity, climate change, and public awareness and participation have acted as SWM drivers towards the current paradigm of integrated SWM. However, urbanization, inequality, and economic growth; cultural and socio-economic aspects; policy, governance, and institutional issues; and international influences have complicated SWM in developing countries. This has limited the applicability of approaches that were successful along the SWM development trajectories of industrialized countries [2].

Proper disposal of municipal solid waste is a major problem in the Metro Colombo Area (MCA). Several proposals have been made in the past, by various agencies to manage solid waste and to implement safe disposal. However, these have failed due to various reasons, particularly the unwillingness by local communities to have a solid waste facility in their close vicinity and concerns on the environmental and social issues. Hence, continuous improper solid waste management or absences of management in the dumping sites have caused severe environmental and social problems in those areas particularly, pollution of nearby water bodies, bad odor, disturbance of waste dumps by scavengers, increased breeding grounds for mosquitos, accidental fire due to landfill gases, etc. The existing dumping sites at Meethotamulla and Karadiyana are good examples for such improper dumping sites. Large quantities of leachate from these two sites severely pollute the three major water bodies; Wears Ganga and Bolgoda Lake from the Karadiaya dumping site and Kelani River from the Meethotamulla dumping site in the Greater Colombo Area. Severe ground water pollution has also been observed. Furthermore, the existing dumping sites in the MCA are over saturated and cannot be continued. Hence, new suitable sites have to be identified immediately for future solid waste management needs [4].

6. Classification of Projects

The EA will be prepared following the World Bank Operational Directive 4.01, dated October 3, 1991, and Operational Directive 4.00, Annex A. dated October 31, 1989.

Governments of Iraq legislations on the topics of landfilling have not yet been fully prepared. However, the EA will be prepared with consideration of the general EIA approach from the national ministry dealing with environmental protection. This TOR has been reviewed with this ministry. The classification of projects which detailed EIA legal (Category B) in article 24, 48 for landfill and solid waste management facility according instruction number (3) 2011of (Environment limiting for concentration of projects and monitoring of safety implement) based on (protection and improvement of the environment law) number (27) 2009.

7. Area of Study

The GPS coordinates for proposed for solid waste management facility in Al-Wihda sub district are (Latitude 33˚ 07.674N Longitude 44˚42.420 E) and as shown in Figure 2.

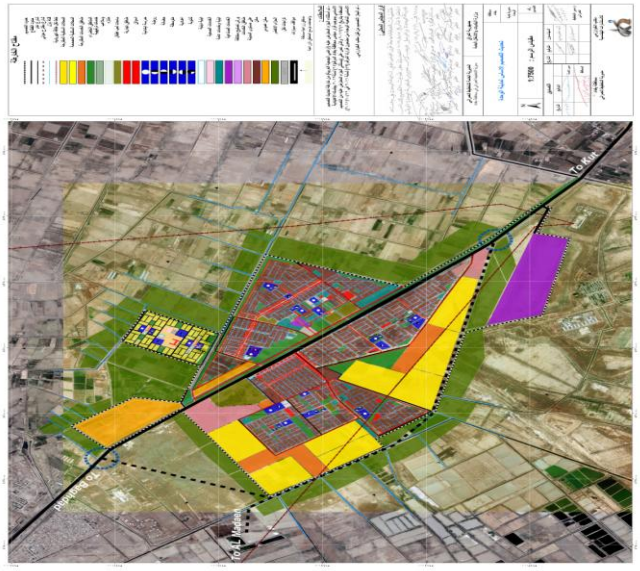

Figure 2: Al-Wihda sub districts border

8. Sampling and Analysis

Treatment water sample from Al-Wihda sub district were prewashed with dilute hydrochloric acid and then rinsed several times with the effluent sample before filling them to the required capacity. These samples were stored at a temperature below 4 ˚C prior to analysis in the laboratory. Procedures followed for analysis have been accordance with the Standard methods for examination of water [8]. The calibration of different chemical constituents was done by preparing low-level standard solutions using AR-grade chemicals and was periodically repeated to check the accuracy. Calcium (Ca^{2+}) and magnesium (Mg^{2+}) was determined titrimetric ally using standard EDTA, while Chloride (Cl) was determined by standard $AgNO_3$ titration. Carbonate (CO_3^{2+}) and Bicarbonate (HCO_3^{+}) were determined by titration with HCl. Sodium (Na^{+}) and Potassium (K^{+}) were measured by flame photometry and Sulphate (SO_4^{2+}) by spectrophotometer turbidimetry. Total Suspended Solid (TSS) and Total Dissolved Solid (TDS) were determined by gravimetric method (dried at 103˚C). The G460 MICROTECTOR 2 Confined Space Gas Detector continuously measure up to six hazards (CO_2, CO, H_2S, SO_2, NO_2 and VOC) in air as shown in Plate (1). This device is one of Environment Research Center/University of Technology equipment.

Plate 1: Device G460 use in the measurement of (CO_2, CO, H_2S, SO_2, NO_2 and VOC)

9. Al-Madain districts survey

Al-Madain districts cover an area of about 53.64 km^2. It is divided into four sub districts which are: Al-Madain center, Al-Wihda, Al-Jesser, Al-Nahrawan, and the following Table (1) shows the area of each municipal unite.

Table 1: Municipal area in Al-Madain districts

No.	*Municipal unit*	*Area Km²*
1	Al-Madain center	21.64
2	Al-Wihda	14
3	Al-Jesser	4
4	Al-Nahrawan	13

10. Calculation of Predict Number of Populations

Al-Madain districts recorded population 383868 and 461107 in the 2009 and 2016 census, receptivity. And we can predict the population to the next 10 years to know how much solid waste will be generate to design and management of solid waste disposal sites, Table (2) shows date of population number taken from ministry of plan. We can use the constant percentage method to calculate the population in 2026 because the visual age of this areal landfill type method is 10 years.

Kp = (ln P2 – ln P1) / (t2 – t1)

Kp = (ln 461107 – ln 383868) / 7 = 0.02619

ln P = ln P2 + Kp (t3 – t2)

= ln 461107 + 0.02619 (10) = 13.3033

Then P = 599170 predict number of populations in 2026

Increase rate of population = (predict population in 2026 – population in 2016) / population in 2016 %

Increase rate of population = (599170 – 461107)/461107 %

= 29.94 % in 10 years

Annual rate = 29.94 / 10 = 2.99%

Table 2: Date of population number taken from ministry of plan

2009			
Al-Madain city	*Urban*	*Rural*	*Total*
Al-Madain center districts	23206	44591	67797
Al-Jesser districts	57120	81511	138631
Al-Wihda districts	91071	86369	177440
TOTAL	171397	212471	383868

2016			
Al-Madain city	*Urban*	*Rural*	*Total*
Al-Madain center districts	27875	53563	81439
Al-Jesser districts	68613	97912	166525
Al-Wihda districts	109396	103747	213143
TOTAL	205884	255223	461107

Note: Population of Al-Wihda sub districts includes the population of Al-Nahrawan sub districts.

11. Calculate of predict of solid waste generation

Prediction of Al-Madain districts solid waste composition and generation rate to determine the required waste volume

which need to disposal, the average of solid waste of human generate 1.1 kg/daily, then we can calculate the predict total account on generate annual solid waste in this equation:

1.1 kg/daily * no. of population * 365 day

We obtain Table (3) which shows the relationship between the predict population increment with solid waste generation during future 10 years.

Table 3: Predict of solid waste generation

Year	*The predict population at 3% increment*	*Predict of solid waste generation Ton/year*
2016	461107	185134.5
2017	474941	190688.5
2018	489190	196409.5
2019	503866	202302
2020	518982	208371.3
2021	534552	214622.4
2022	550589	221061.3
2023	567107	227693.3
2024	584121	234524.3
2025	601645	241560.3
2026	619695	248807.3
Total	------	2371174.7

We can compare between actual and predict of solid waste generation value to calculate the municipal efficiency working:
Municipal efficiency working = (140651+ 12787) / (2371174.7/11) *100% = 71.18%
This value is logical and acceptable value.

12. Calculate of Predict of Municipal Separated Solid Waste Generation

From experiment work in Al-Mahmoudia solid waste management facility for similar composition of solid waste shows that 75% solid waste was been recycle (10% recycle material, 25% organic fertilizer, 30% moisture content, and 10% organic waste dumping) and 25% dump directly as shown in Figure 3. Tables 4 and 5 shows the results of predict of municipal solid waste.

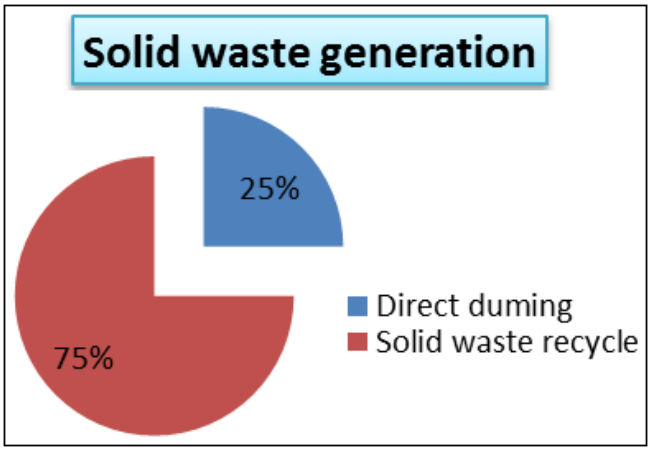

Figure 3: Solid waste generation

Table 4: Calculate of predict of municipal solid waste generation

	Separation solid waste generation %	*Ton /10 years*	*Type of solid waste generation*
1	25	2371174.4 * 0.25= 592793.6	Direct dumping
2	75	2371174.4 * 0.75=1778380.8	Solid waste recycles

Table 5: Calculate of predict of separated solid waste composition

	Separation %	Ton /10 years	Type of solid waste
1	13.33	1778380.8*0.133=237117	Recycle material
2	13.33	1778380.8*0.133= 237117	Organic waste dumping
3	33.33	1778380.8*0.333= 592787.7	Organic fertilizer
4	40	1778380.8*0.40= 711352.3	Moisture content
Total municipal separated solid waste generation 1778380.8 Ton /10 years			

Total solid waste dumping
592793.6 + 237117 = 829910.6 Ton/10year

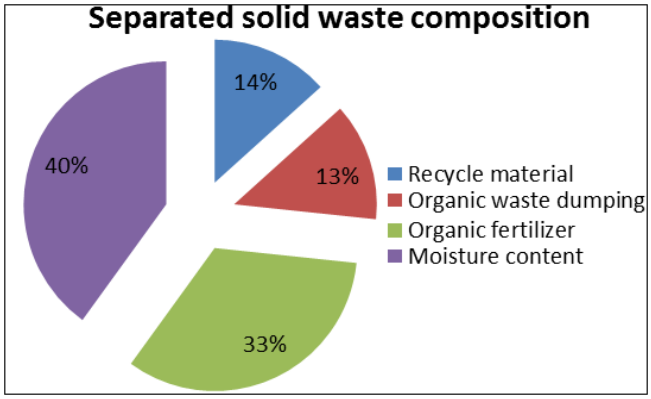

Figure 4: Separated solid waste composition

A sample of 100 kg of the municipal solid waste taken from the damping land near the regain under study. Table 6 shows the characteristic of this sample.

Table 6: Characteristic of municipal solid waste

No.	*Characteristic*	*Percentage %*
1	Garbage and other materials	76
2	Steel	7
3	Aluminum	3
4	Plastic	5.5
5	Glass	2.5
6	Paper, Carton, Temper	6

13. Sanitary Landfill Volume

Sanitary Landfill volume plan considering amount of solid waste are shown Table 7.

- Open year: 2016
- Sanitary Landfill lifespan: about 10 years (227.37 ton/day)
- Land-filling capacity: About 829910.6 tons
- Lifespan of landfill Phase 1: More than 5 years
- Density of MSW: 0.8 ton/ m^3, Settlement: 25% of Landfilled Waste, Soil

Covering: 10% (Applied in detailed design based on MSW analysis)

Table 7: Calculation of land-filling capacity

Year	*1*	*5*	*10*
Landfilling (ton/year)	82991.104	414955.52	829911.04

Table 8: The Air pollutant concentration at the study area vs. proposed standard limit reading ppm exposed one hour

No.	*Air pollutant*	*Minimum*	*Maximum*	*Mean*	*SD*	*proposed standard limit*
1	VOC	0.29	0.32	0.3	0.02345	---
2	CO_2	0.01	0.01	0.01	0	---
3	CO	3.8	4.1	4	0.12247	35
4	H_2S	0	0	0	0	---
5	SO_2	0.04	0.06	0.05	0.00707	0.15
6	NO_2	0	0	0	0	0.25

14. Conclusions

- The project is an essential part of the overall improvements that are being carried out of Al-Wihda sub district and is meeting a long overdue demand to dispose municipal solid waste in a more environmentally friendly manner.
- The selected location is suitable for constriction the solid waste facility according to the EIA legal (Category **B**) in article **24, 48** for landfill and solid waste management facility number **(3) 2011** based on law number **(27) 2009**.
- The selection of area method for damping solid waste seems the most properties method because of the level of groundwater in this region is so high and there is a wide area for this type of method.
- The proposed project with **62500** meter square area will serve Al-Madain districts which covered **53.64** Km^2 area with **461107** capita for ten next years.
- The proposed project will be able to recycle about (**75%**) of generated solid waste and it will able to damp the residual percentage (**25%**) for predict ten years which about (**2371174.7** Ton).
- The observe components of the solid waste content mostly of garbage (**76%**), steel (**7%**), aluminum (**3%**), plastic (**5.5%**), glass (**2.5%**) and (paper, carton, temper) (**6%**). Some of these components can be recycling and reused again as a raw material.
- The experiential data show that the irrigation water in the surrounding reign within the National determinants for the use of treated wastewater for agricultural irrigation number **(3) 2012**.
- Air pollutant concentrations at the study area within the Iraqi proposed standard limit.
- The proposed project has got approver of the community because of its economical income, provide job for the citizen and improve Infrastructure of service area.

15. Recommendations

- The authorities expect to bring many management measures to reduce the waste generated by introducing household level programs. However, it is noted that several specified and informal attempts lead by local authorities and non-governmental organizations have contributed to reduction of waste but needs greater support and encouragement to promote this to make a significant reduction in the waste generation.
- Previous attempts to disposed solid waste randomly had not succeeded due to various reasons, so this compelled the authorities to select landfill in remote areas such as the reign we select as the most practical option in spite of the fact that no suitable lands are available without a reasonable distance from center of city.
- The legal clearance must be obtained from the responsible department of wildlife conservation for the establishment of the proposed site.
- Social and health issues considered by the sociological experts are of the view that more effective strategic intervention with the community can alleviate their concerns and protests if the benefits and measures taken to safeguard their interest and ecosystem can be explained.
- The focus of these potential impacts to landscape and the potential wind impacts on the operations of the landfill when unloading garbage that can be blown away, it is recommended to properly maintain the proposed buffer zone with green vegetation cover.
- In order to minimize the time schedule for final design of a new sanitary landfill, the baseline studies for the full Environmental Assessment (EA) could begin as soon as it becomes clear which of the more than two sites are to be selected for final design. Therefore, the baseline studies might begin in parallel with the final stages of preliminary design, assessment, and costing of the above-mentioned siting design study.
- Recycling of the district, Baghdad Governorate municipal solid waste needs to be on scope of future waste management studies, for design, locating sorting and separation processes according to recyclable waste percentages found.

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Author Profile

Haider Kareem Ali Obtained a bachelor's degree in Mechanical Engineering/ University of Mustansiriyah in 2003 and Higher Diploma of Environmental in 2016.