Quantification of Methane Emission for Tanjaro Dumping Site in Sulaymaniyah-Iraq and Implementing Compatible Methane Abatement Strategies for the City

Peshang Hama Karim[1] & Piotr Manczarski[2] & Saban Kara[3]

[1,2] Division of Environmental Engineering, Faculty of Building, Hydro and Environmental Engineering, Warsaw University of Technology, Warsaw, Poland
[3]Department of English Language Teaching, Faculty of Education, Tishk International University, Erbil, Iraq
Correspondence: Peshang Hama Karim, Warsaw University of Technology, Warsaw, Poland.
Email: eng.peshang@yahoo.com

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Abstract: This research indicates another source of income from waste, which is called "Power Generation from Landfill Gas." It is known that while the waste is dumped into a dumping site or a landfill, because of the chemical reactions between the wastes, some gases (i.e., greenhouse gases) are generated. The most well-known one is methane gas (CH_4). Methane gas can be used for heat consumption or as a source of electricity. Implementing the 2006 IPCC method to find the amount of methane gas that will be generated from the Tanjaro dumping site, the amount of electricity will be calculated. The main objective of this project is to quantify methane emissions that may be generated from landfill in Sulaymaniyah between the period of 2005 and 2030 and to recommend possible methane abatement strategies. IPCC Model is used to estimate the methane potential of the landfill in Sulaymaniyah. Implementing this project, the electricity problem of neighboring industries will be shortened, and methane gas emission will be solved properly. Also, this project can be a scientific proposal for local authorities to encourage them invest on the project and decrease methane contribution risks on local environment.

Keywords: Intergovernmental Panel On Climate Change (IPCC), Methane Gas (CH_4), Methane Correction Factor (MCF), Greenhouse Gases (GHG), Landfill Gas (LFG), Refuse Derived Fuel (RDF), Municipal Solid Waste (MSW), Degradable Organic Carbon (DOC), Solid Waste Disposal Site (SWDS), Mega Gram (Mg), Kurdistan Region of Iraq (KRG)

1. Introduction

Kurdistan Region of Iraq is a federal region that is recognized internationally and it's located on 36° North, 44° East in Northern Iraq, Middle East. Kurdistan means "land of Kurds" and There are four main cities in that region which are Erbil 'capital', Duhok, Sulaymaniyah, and Halabja. The total population of the area in 2017 was estimated at 5.7 million inhabitants. The official language of the region is Kurdish, with the Sorani accent. In 2016 the total GDP (nominal) was calculated as 23.6 billion US dollars. The weather condition of the region varies a lot from winter to summer in which in summers it may reach 40 Celsius degrees and in winter to -1 Celsius degree. So, it's a warmer area than fresh (History and geographical background of Kurdistan Region in Iraq, 2020).

Sulaymaniyah is the capital of culture in Kurdistan Region, which is in northern Iraq. It was established by "Ibrahim Pasha Baban" in 1784. It's a mountain area and famous for its heavy wind. The city has around 2.1 million inhabitants -city center is around 1 million (Othman, Kane, & Hawrami, 2017). The city is about 100 km away from the Iranian border and in the region of the city, there are so many resorts for picnic and nature where people can go, especially in summer, when the temperature rises.

The annual average temperature range of the city is 38 in summer and 0 Celsius degree in winter. The annual average rainfall precipitation is 750 mm (Zakaria-Mustafa et al., 2013). It is important to know that mostly there isn't any precipitation from June till September. So, each year's lack of water in those months is a priority problem for the authorities. Most of the population of the city are living in an urban area, while others are living in a rural area and their primary income is agriculture and industrial agriculture.

Sulaymaniyah is a modern city in northern Iraq. Within the gradual growing of the population in the last decades, waste generation increased, as well. Technically, in the center of society life, educators have a great position and responsibility to lead the community and they can raise the awareness of the topic in institutions and activate pre-existing knowledge of clean environment by extracurricular activities (Tosun &Yildiz, 2015a). Yildiz and Budur (2019) argue that "three main important elements, which are environmental knowledge, attitudes and behavior, and awareness can be transferred to learners with curricular or extracurricular activities" (p.674). Hence, educators' job is sacrificing, and all the great personalities made are their fruits. Moreover, there is an enormous burden on their shoulders (Tosun &Yildiz, 2015b). Public's competence applying the required steps in protecting the environment takes paramount place depending on the aim-based education and it is provided by the dedicated educators (Yildiz, 2017a). "Teachers are essential to universal and quality education for all: they are central to shaping the minds and attitudes of the coming generations to deal with new global challenges and opportunities" (Yildiz, 2017b, p.115). Because the people's lack of knowledge and not being a well-developed country yet, the waste of Sulaymaniyah has not been managed properly and been dumped in Tanjaro (waste pouring area) which has been one of the most environmentally dangerous places in Sulaymaniyah. "Actions that people take cause the fatal damage to the natural environment and operate unimaginable destructions" (Yildiz, 2019, p.102). Based on this reality, Tanjaro has become the source and center of pollution and diseases in the city. Last year, after a natural explosion related to the squeezed gas in the dumping site, smoke covered over the region for about a week. Moreover, due to the lack of a stable economy, the Kurdistan Regional Government (KRG) should look for alternative sources of income.

Corporate social responsibility is a crucial and remarkable issue in business ethics (Ali & Yildiz, 2020) and based on this responsibility, government and/or private organizations can find many ways to get financial income from waste. In this global age, businesses have become more vital than before with their great influence on economic development of the country (Yildiz & Amin, 2020). In this context, more recyclables can be generated from source-separated wastes, and eventually more income-because the quality of recyclable waste will be higher. Another income source from waste is to compost bio-waste and green wastes. In addition, the type of waste which is called RDF (Refuse Derived Fuel) can be used in cement factories.

Nowadays waste management has started to become a crisis in Sulaymaniyah, because the amount of waste stream increases each year, and on the other hand, there isn't any proper standard landfill unfortunately for disposal process of wastes. Private sectors do transportation of wastes from houses till the dumping site, but there with the help of methane gas and hot weather condition, start to burn. We have this case almost in every dumping place of the city which is more than 75 dumping sites. The biggest one is the "Tanjaro Dumping site," which is located 5 KM south of Sulaymaniyah. So, the largest dumping site is very near to the city, and with the growth rate of the population, it will be inside the city in the following years. If so, it will be a disaster. Tanjaro has a substantial adverse effect impact over the residence of Sulaymaniyah by polluting Air and groundwater. Since there is Tanjaro river

flowing beside the Dumping site. The most dangerous part of this is that the farmers are using the Tanjaro river to irrigate their farms and then they sell their product to local markets. Unfortunately, there is not any quality control for it. Typically, many types of research dedicated that the river is polluted and using its water for any domestic use is prohibited, but still, it is being used (Majid, Khwakaram, Gado, & Majeed, 2018).

Many industrial companies work in the province like (Gypsum, Cement, Masons, Steel, Oil refinery, Pharmaceutical, …etc.). Also, there are many agricultural farms in which they all have their source of waste and pollution. Hence, the Tanjaro dumping site case is a fatal situation for Sulaymaniyah and immediate action is needed to deal with methane gas coming from the dumping site and reclamation of the area. Now each day about 1200 mg of waste is put in Tanjaro Dumping site each day. Authorities in Sulaymaniyah are building a new standardized sanitary landfill in the region and it's expected to finish in 2 years. After that period, they will put all wastes into that new standardized landfill.

Figure 1: Tanjaro dumping site in 2018, (Own Photo, 2018)

Figure 2: Tanjaro Dumping site and Tanjaro River, (The picture of polluted Tanjaro river in BBC Arabic report)

The dumping ground is 5 km far from city. It extends over 25 hectares and receives 500 metric tons of waste, 60 metric tons of silt and 5 tons of bio-medical waste daily. Between March and June, the daily amount of silt rises to more than 1000 metric tons because of drain cleaning in advance of the construction season. Also, the oil spill at that region is very high.

Figure 3: Distance of dumping ground from Sulaymaniyah, (Map of Sulaymaniyah province and Tanjaro dumping site).

Around 65% of Sulaymaniyah waste generation from 1200 Mg MSW is food waste. Plastics and inert composition are 19%. Paper is 9%. Other compositions are around 5%.

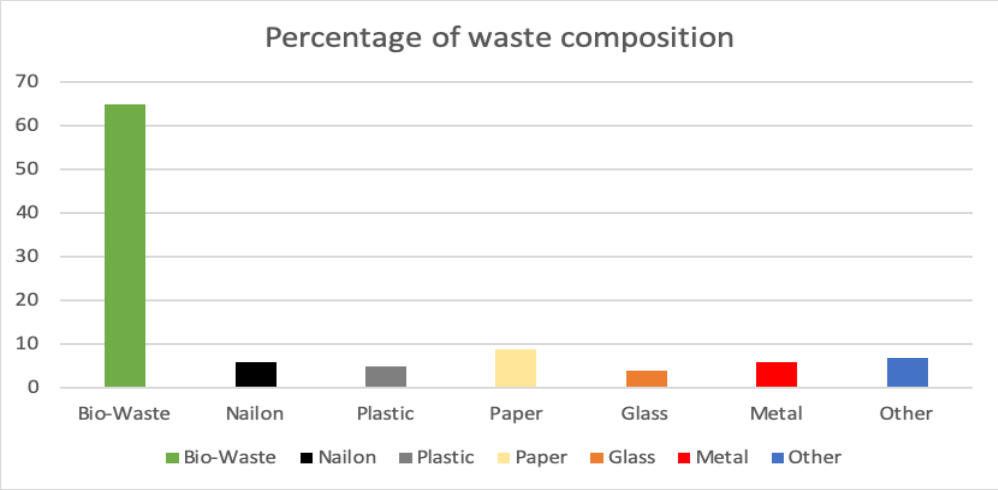

Figure 4: Waste composition percentage in Sulaymaniyah, (General Directorate of Municipalities of Sulaymaniyah, 2018)

The main objective of this project is to quantify methane emissions that may be generated from dumping site in Sulaymaniyah for the period 2005 to 2030 and recommend possible methane abatement strategies. 2006 IPCC Model for National Greenhouse Gas Inventories (IPCC model, 2006a) is used for the estimation of methane potential from the landfill in Sulaymaniyah.

2. IPCC MODEL Methodology

In-order for the system to work and estimate methane emission, input parameters should be well-known and filled properly according to reliable situation of estimated SWDS.

2.1 Parameters

Degradable organic carbon: The portion of organic carbon present in such solid waste as paper, food waste, and yard waste that is susceptible to biochemical decomposition.

DOC is calculated by the composition of the waste as different types of wastes have different DOC values. This can be (Food waste, Garden waste, Paper waste, Wood and straw, Waste from textiles, Waste from disposable nappies, Sewage Sludge).

For almost all cases, one must choose a proper DOC value which represents the reality of income waste to disposal site. Taking into consideration that Sulaymaniyah is considered as a dry temperate.

Methane generation rate constant (k): The methane (CH_4) generation rate constant (k value) is an essential parameter when using first-order decay (FOD) landfill gas (LFG) generation models to estimate CH_4 generation from landfills. Methane generation rate constant depends on the climate of landfill site. Iraq, being a dry country, the conditions selected is Dry Temperate.

2.2 MCF (Methane Correction Factor)

The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less CH_4 from a given amount of waste than managed SWDS because larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Table 1: Worksheet with MCF data

	Unmanaged, shallow	Unmanaged, deep	Managed	Managed, semi aerobic	Uncategorized	Distribution check
	MCF	MCF	MCF	MCF	MCF	
IPCC default	0,4	0,8	1	0,5	0,6	
	Distribution of waste by waste management type					
"Fixed" country specific value	0 %	100 %	0 %	0 %	0 %	Total (100%)
Year	%	%	%	%	%	
2005	0%	100%	0%	0%	0%	100%
2006	0%	100%	0%	0%	0%	100%
2007	0%	100%	0%	0%	0%	100%

2008	0%	100%	0%	0%	0%	100%
2009	0%	100%	0%	0%	0%	100%
2010	0%	100%	0%	0%	0%	100%
2011	0%	100%	0%	0%	0%	100%
2012	0%	100%	0%	0%	0%	100%
2013	0%	100%	0%	0%	0%	100%
2014	0%	100%	0%	0%	0%	100%
2015	0%	100%	0%	0%	0%	100%
2016	0%	100%	0%	0%	0%	100%
2017	0%	100%	0%	0%	0%	100%
2018	0%	100%	0%	0%	0%	100%
2019	0%	100%	0%	0%	0%	100%
2020	0%	100%	0%	0%	0%	100%
2021	0%	100%	0%	0%	0%	100%
2022	0%	100%	0%	0%	0%	100%
2023	0%	0%	100%	0%	0%	100%
2024	0%	0%	100%	0%	0%	100%
2025	0%	0%	100%	0%	0%	100%
2026	0%	0%	100%	0%	0%	100%
2027	0%	0%	100%	0%	0%	100%
2028	0%	0%	100%	0%	0%	100%
2029	0%	0%	100%	0%	0%	100%
2030	0%	0%	100%	0%	0%	100%

We have considered the years of operation from 2005 to 2030 in the model so that we would be able to calculate methane emission for 25 years. The operation of landfill will start in 2005 in an unmanaged, deep landfill, for a period of 18 years. Then the landfilling operation is shifted from unmanaged deep landfill to managed landfill from 2023 till 2030, where the landfill is closed.

2.3 MSW Activity Data

Actually, landfilling is the only way of municipal solid waste (MSW) disposal in Sulaymaniyah (Karim, 2019). Percentage of urban waste land filled; the quantity of MSW send to landfills is 100%. According to 2020 statistics, the population of Sulaymaniyah is 1 million. The average population growth is relatively high with 3% per year. Total daily amount of MSW is 1200 Mg. The projection of Sulaymaniyah population is calculated with the formula which multiplication of the population by growth rate for each year.

Total amount of MSW is 1200Mg/day in Sulaymaniyah. In order to compute MSW generation rate (kg/capita/day) the daily amount of MSW generated in Mg is by the following formula.

*MSW generation rate (kg/capita/day) = (Daily amount of MSW generated (Mg MSW)/ Population whose waste goes to SWDSs) * 365 *10^3*

Example MSW generation rate calculation for year 2020:

MSW generation rate = (1200 Mg/day / 1 000 000) * 365 *10^3= 438 kg/capita/day

In order to compute net annual methane emission in Gg the Annual amount of MSW generated in m^3 has to be converted into the annual amount of MSW generated in Gg. The following formula is used from IPCC guideline.

*Annual amount of MSW generated (Gg MSW) = Population whose waste goes to SWDSs * MSW generation rate (kg/capita/day) * 365/10^6 * Fraction of MSW disposed to SWDSs*

Waste composition remains roughly the same for 15 years. This distribution is expressed in percentage. But it will change when some sorting facilities open in Sulaymaniyah region.

Table 2: Worksheet with MCF activity data

					Composition of waste going to solid waste disposal sites							
Year	Population	Waste per capita	Total MSW	% to SWDS	Food	Garden	Paper	Wood	Textile	nappies	Plastics, other inert	Total
	Millions	Kg/cap/yr	Gg	%	%	%	%	%	%	%	%	(=100 %)
2005	0,55	378	207,9	100 %	65%	1%	9%	1%	2%	3%	19%	100%
2006	0,58	382	221,56	100 %	65%	1%	9%	1%	2%	3%	19%	100%
2007	0,61	386	235,46	100 %	65%	1%	9%	1%	2%	3%	19%	100%
2008	0,64	390	249,6	100 %	65%	1%	9%	1%	2%	3%	19%	100%
2009	0,67	394	263,98	100 %	65%	1%	9%	1%	2%	3%	19%	100%
2010	0,7	398	278,6	100 %	65%	1%	9%	1%	2%	3%	19%	100%

2011	0,73	402	293,46	100%	65%	1%	9%	1%	2%	3%	19%	100%
2012	0,76	406	308,56	100%	65%	1%	9%	1%	2%	3%	19%	100%
2013	0,79	410	323,9	100%	65%	1%	9%	1%	2%	3%	19%	100%
2014	0,82	414	339,48	100%	65%	1%	9%	1%	2%	3%	19%	100%
2015	0,85	418	355,3	100%	65%	1%	9%	1%	2%	3%	19%	100%
2016	0,88	422	371,36	100%	65%	1%	9%	1%	2%	3%	19%	100%
2017	0,91	426	387,66	100%	65%	1%	9%	1%	2%	3%	19%	100%
2018	0,94	430	404,2	100%	65%	1%	9%	1%	2%	3%	19%	100%
2019	0,97	434	420,98	100%	65%	1%	9%	1%	2%	3%	19%	100%
2020	1	438	438	100%	65%	1%	9%	1%	2%	3%	19%	100%
2021	1,03	451,14	464,6742	100%	65%	1%	9%	1%	2%	3%	19%	100%
2022	1,0609	464,6742	492,9729	80%	73%	5%	5%	5%	3%	1%	8%	100%
2023	1,092727	478,6144	522,9949	80%	73%	5%	5%	5%	3%	1%	8%	100%
2024	1,12550881	492,9729	554,8453	80%	73%	5%	5%	5%	3%	1%	8%	100%
2025	1,15927407	507,762	588,6354	80%	73%	5%	5%	5%	3%	1%	8%	100%
2026	1,19405 23	522,9949	624,4833	80%	73%	5%	5%	5%	3%	1%	8%	100%
2027	1,22987387	538,6848	662,5143	70%	73%	5%	5%	5%	3%	1%	8%	100%
2028	1,26677008	554,8453	702,8614	70%	73%	5%	5%	5%	3%	1%	8%	100%

2029	1,30 477 318	571, 490 7	745,6 657	70%	73%	5%	5%	5%	3%	1%	8%	100%
2030	1,34 391 638	588, 635 4	791,0 767	70%	73%	5%	5%	5%	3%	1%	8%	100%

2.4 Amount Deposited Data

In this part, the waste distribution in Gigagrams calculated automatically by the model according to the activity data waste composition percentages as shown below.

Table 3: Worksheet with computed values of waste composition

	Amounts deposited in WSDS									
Year	Food	Garden	Paper	Wood	Textile	Nappies	Sludge	Deposited MSW	Inert	Industrial
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
2005	135	2	19	2	4	6	0	208	40	0
2006	144	2	20	2	4	7	0	222	42	0
2007	153	2	21	2	5	7	0	235	45	0
2008	162	2	22	2	5	7	0	250	47	0
2009	172	3	24	3	5	8	0	264	50	0
2010	181	3	25	3	6	8	0	279	53	0
2011	191	3	26	3	6	9	0	293	56	0
2012	201	3	28	3	6	9	0	309	59	0
2013	211	3	29	3	6	10	0	324	62	0
2014	221	3	31	3	7	10	0	339	65	0
2015	231	4	32	4	7	11	0	355	68	0
2016	241	4	33	4	7	11	0	371	71	0
2017	252	4	35	4	8	12	0	388	74	0
2018	263	4	36	4	8	12	0	404	77	0
2019	274	4	38	4	8	13	0	421	80	0
2020	285	4	39	4	9	13	0	438	83	0
2021	302	5	42	5	9	14	0	465	88	0
2022	288	20	20	20	12	4	0	394	32	0
2023	305	21	21	21	13	4	0	418	33	0
2024	324	22	22	22	13	4	0	444	36	0
2025	344	24	24	24	14	5	0	471	38	0
2026	365	25	25	25	15	5	0	500	40	0
2027	339	23	23	23	14	5	0	464	37	0
2028	359	25	25	25	15	5	0	492	39	0
2029	381	26	26	26	16	5	0	522	42	0
2030	404	28	28	28	17	6	0	554	44	0

2.5 Recovery-OX

In this part, it is considered that the CH_4 recovery value is zero as default.

2.6 Results

Annual methane emissions from the landfill are calculated by the formula below.

M= (K – L) *(1-OX)

Where,

M = Methane emitted, Gg.

K = Total Methane generated from the waste, Gg.

L = Methane recovered, Gg.

OX = Methane Oxidized.

Methane Emission(L): Methane generated for each waste fraction is calculated in a separate worksheet. Annual methane emissions from Tanjaro landfill is calculated for each year from 2005-2030. Some of the results is listed in the Table 4 below:

Table 4

Methane Emission	Amount in Giga gram (Gg)	**year**
Minimum	0,536 Gg	2005
Maximum	17,21 Gg	2030
Average	8,338 Gg	~2018
Total	216,777 Gg	2005-2030

3. Methane Emissions from Landfill

Landfill gas (LFG) can be successfully used to replace other energy sources. Collected methane from landfills can be burned to generate electricity, heat buildings, or power garbage trucks.

In Sulaymaniyah, there is no need for heating buildings in surroundings of landfill because temperature remains high throughout the year. Therefore, the best option of evaluating the landfill gas is electricity generation. It offers major air quality benefits where landfill exists.

Combustion of LFG to produce energy contributes to GHG emission reduction in two ways. LFG capture prevents the release of methane into the atmosphere as a GHG methane is 23 times as powerful as CO_2 in average (Crosson, 2008) and the electricity subsequently produced by LFG combustion produces less CO_2 emission than conventional fossil fuel combustion. However, landfill gas combustion produces also some CO_2, the impact of these emissions on global climate change is offset many times over by the methane emission reductions (Montzka, Dlugokencky, & Butler, 2011).

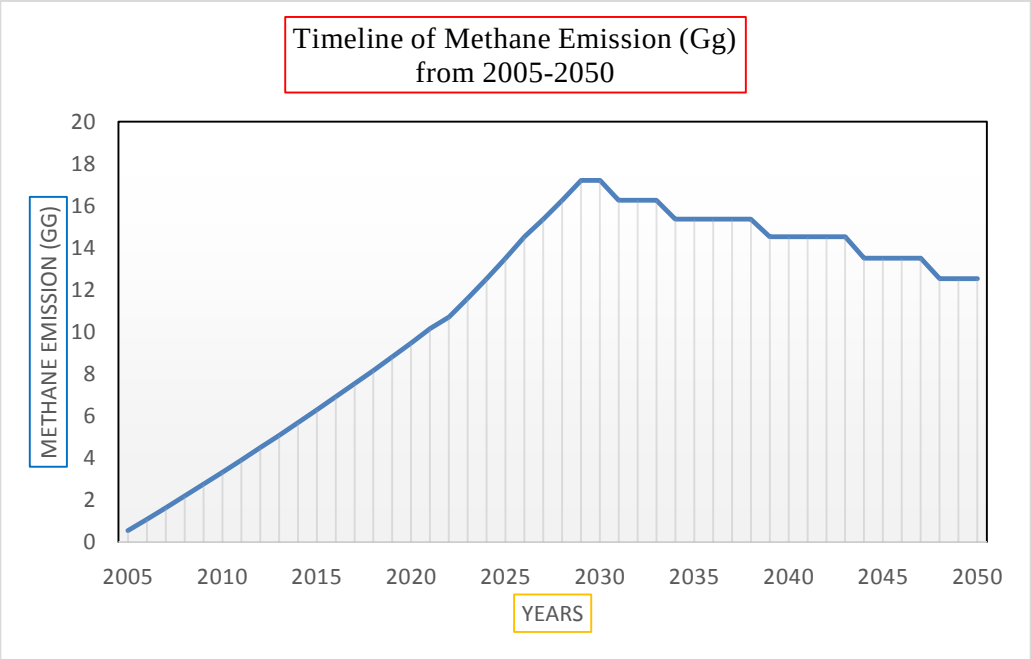

Figure 5: Methane emissions from landfill in Sulaymaniyah, (Calculated Excel sheet)

According to IPCC Model results, the annual methane emissions from landfill are shown in Figure 8. It can be seen from the graph that methane emissions increase during the operation time (2005-2030) and reach to maximum in 2030. After the closure of landfill, gas production decreases steadily for a certain amount of period with slow rates till 2050. But if the facility continues to function as waste disposal site, so the range will increase.

The emissions can be calculated as Mm^3 as well. To calculate the amount of methane emission as Mm^3 the formula below is used.

*The volume of methane (Mm^3) = [The amount of methane (Gg) * 10^6 (kg/Gg)] / [Density of methane * (10^6 (m^3/Mm^3)]* (Kumar, Mondal, Gaikwad, Devotta, & Singh, 2004)

The density of methane at 25°C is 0.657 kg/m^3 (Kleinrahm, Duschek, Wagner, & Jaeschke, 1988).

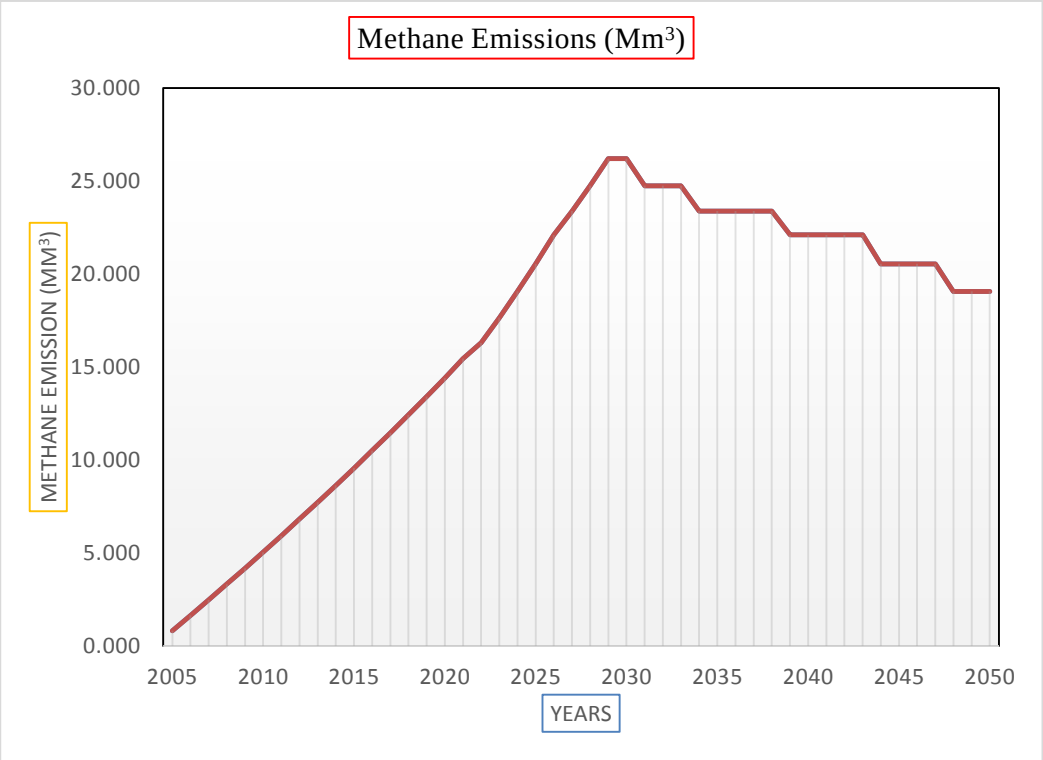

Figure 6: Methane Emission from landfill in Sulaymaniyah (Mm^3), (Calculation of IPCC formulas from Excel file)

4. Electricity Generation from Methane

The first step in converting methane to usable energy is to collect the methane gas. Collection system designs and recovery efficiency vary by site. For this analysis, the key factor is collection system efficiency (Huitric, & Kong, 2006).

To calculate the amount of collected methane, the formula below is used.

*The amount of collected methane (Gg) = [The amount of methane (Gg)*Collection efficiency]*

[For Tanjaro Collection efficiency of collected methane is assumed as 50%].

In order to calculate the potential electrical energy amount, the collected amount of methane in Kg is converted into electrical energy unit in kWh where energy content of methane is 50MJ/kg (World Nuclear Association, 2018). In this point, it is assumed that energy conversion factor of generating electricity from methane is 55%.

*The estimated amount of electricity generated (kWh) = [The amount of collected methane (Gg) * 50 MJ/kg *10^6(kg/Gg) * (1kWh /3.6 MJ) * Energy conversion efficiency]*

Energy conversion efficiency = 55%. (Malik, Lerner, & MacLean, 1987).

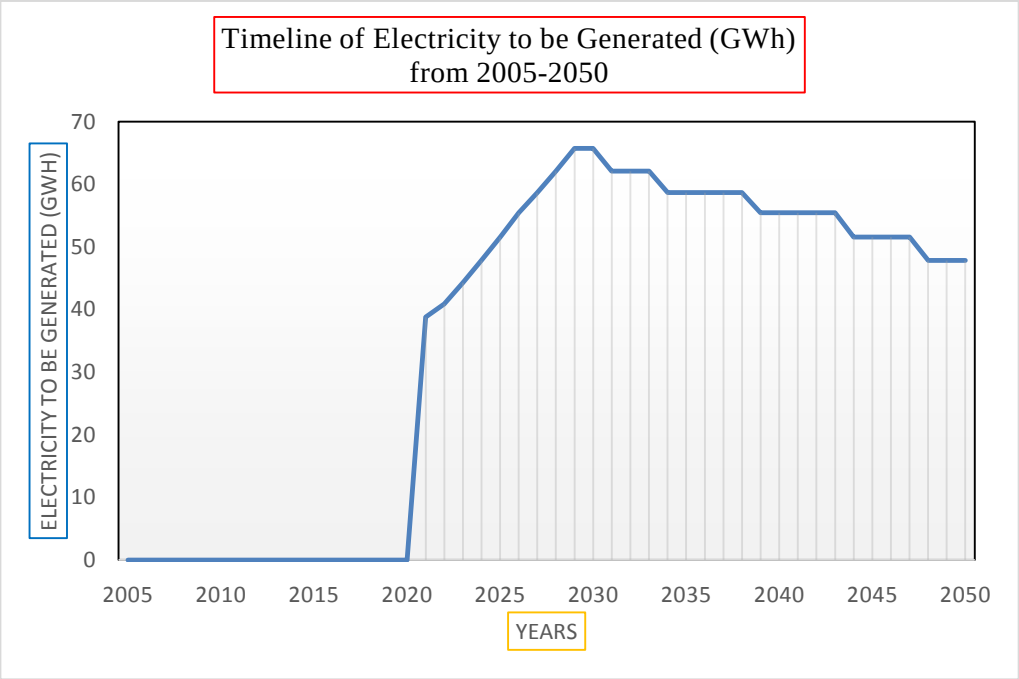

Figure 7: Annual Electricity Generation from landfill in Sulaymaniyah, (Al Manmi, Mohammed, Abdullah, Al-Jaf, & Al-Ansari, 2019)

It can be seen from the graph that electrical energy generated from methane increases during the operation time (2018-2027) and reach to maximum in 2029. After the closure of landfill, electricity generation continues for a certain amount of period with slow rates till 2050. In this project we have dedicated the projection range till 2050, but if we want to know the last year which Tanjaro could emit methane, we will have to elongate the projection. By a symmetrical projection, we can indicate that the last year of methane emission would be around 2200. This is in case if input waste to Tanjaro stopes in 2030. Table 5 below shows some bullet projection dates, amount of methane generation with its capacity of generating electricity (calculation excel sheet, 2020).

Table 5: Amount of methane generation for generating electricity

Year	Methane emission (Gg)	Electricity to be generated (GWh)
2005	0,536	0
2018	8,163	0
2030	17,210	65,73
2050	12,524	47,83
2100	1,079	4,12
2150	0,04	0,15
2200	0,001	0,00

It can be seen from the graph that till 2020, amount of generated electricity is 0 GWh. The cause of this is that till now, there isn't any facility for electricity production in Tanjaro.

5. Discussion and Conclusion

Generally, 90% of open dumpsites and especially Tanjaro dumpsite in Sulaymaniyah are in an emergency situation. In order to start closing and making reclamation for those dumpsites, at least one sanitary landfill should start to operate in the province. Groundwater of Tanjaro is contaminated and it's a source of water domestic use of Sharazour and Darbandikhan. From this perspective, Tanjaro dumpsite is now a life-threatening source that kills the population nearby slowly. So, the authorities should announce a red alarm for Tanjaro dumpsite and start making contracts with qualified international companies for making proper treatment and closure of the dumpsite. If the authorities choose silence regarding this disaster, they will intensively be responsible of killing their own nation and next generation.

Reclamation is very important factor for reintroducing an area to nature again. We need a proper plan for steadily making reclamation of the areas that were disturbed by wastes, i.e., waste transfer stations, open dumpsites in Sulaymaniyah. This step will decrease health risk on residents.

The industries which are near Tanjaro are also dumping their leachate and wastes into Tanjaro river. By this, the contaminated river becomes dirtier and more life-threatening. They should be obliged to use "compact unit system" and their waste should be directed to hazardous waste landfills. In Europe, the restaurants are obliged to put a system before directing wastewater to main sewages. That system filters wastewater from oils (Malinauskaite, ... & Anguilano, 2017). The oil is filtered, and wastewater is directed to sewage. Every month a company comes and cleans the filters and take waste oil and direct it to waste oil treatment plant.

The government should give all authority to waste management department to enforce third party to do their job according to rules and legislations. If they didn't act accordingly, waste management department should have enough authority to punish them.

During this research, some bullet points were observed which are explained below:

- The dry climatic conditions of Sulaymaniyah do not facilitate the production of methane gas.
- Increase in the moisture content of waste leads to increase in methane gas production as it aids in anaerobic decomposition process.
- When the depth of the landfill is more, will have more Methane gas generation.
- A well-managed landfill will have more methane generation, as it was seen in the calculations in MCF worksheet from 2023 to 2030.
- Food waste is a major contributor to methane gas as food waste has higher concentration of organic carbon as compared other wastes.
- There is steady increase in methane production and electricity generation till year 2030, after that they decrease significantly till year 2200.
- The amount of methane from landfill in 2030 has the maximum value of 17,21 Gg.
- The amount of electricity produced from methane in 2030 has the maximum value of 65,73 GWh. Which equals to 4,4 MW electricity if it works 24 hr/ day. This can generate power to more than 3000 homes in the region. Or it can be given to the industrial facilities near Tanjaro dumping site.

- LFG capture projects prevent the emissions of methane and other pollutants from landfills. They are environmentally friendly and generate renewable energy from waste without releasing extra GHGs which eventually contribute to Climate change and global warming.
- After implementing this project, a reclamation process can be started with the process of dumping site closure. This would decrease the problems of groundwater pollution and prevents air pollution of Sulaymaniyah from Tanjaro.
- This process would save life of thousands who live near Tanjaro, and another explosion would be prevented.

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