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Research Paper

Methane Emission from Municipal Solid Waste Landfill Sferka in Peja Region

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Abstract: The paper presents an estimation of methane emission from deposited municipal solid waste in Sferka landfill for the years 2006–2016 and and projections of methane emissions for the time period 2017-2022. Methane emission was calculated according to the methodology recommended by IPCC 2006, using default values. Within framework of the research the following parameters were evaluated: amount of landfilled waste, landfill characteristics, composition of landfilled waste and climate conditions of the region. Based on these parameters, the total amount of CH_4 emitted from the landfill during 2006–2016 was estimated at 8 Gg or 200 Gg CO_2 eq. The total mass of CH_4 for the time period 2017–2022 is projected to be 13 Gg, or 325 Gg CO_2 eq.

Keywords: *waste, solid, municipal, methane, landfill, emission*

Introduction

Landfill gas emission from municipal solid waste landfills plays a significant role causing global climate changes. These waste disposal sites are considered as one of the most important anthropogenic sources of greenhouse gases, especially methane gas, which has global warming potential 25 times of carbon dioxide (IPCC 2006). CH_4 emission from landfills is continually increasing owing to increasing population growth and per capita waste generation, with landfills ranking as the third-largest anthropogenic CH_4 source (Ritzkowski *et al*, 2007).

CH_4 emissions from managed landfills accounted for 1.8% of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from managed landfills declined by 47% in the EU-15. A main driving force of CH_4 emission reduction was the amount of biodegradable waste going to landfills which declined by 53% between 1990 and 2011 (Eurostat, 2014). Before 2000, most of the solid waste collected from urban areas in Kosovo was deposited in unmanaged landfills or waste dump sites. During the past decade (2006-2016), there was an improvement of waste disposal practice from open dumping and unmanaged landfills to sanitary managed landfills. This improvement of waste management increased the amount of waste disposed. At present, about 60% of the solid waste is disposed in sanitary landfills. (KEPA, 2015), (KAS, 2017). The GHG emissions from waste management in Kosovo represent around 4% of the total GHG national emissions. Methane emissions from managed municipal solid waste landfills are major source of GHG emissions from the waste sector in Kosovo (KEPA, 2015; UNDP Kosovo, 2012). There are 6 municipal and regional waste landfills in the territory of Kosovo, which are considered as potential hotspots. These landfills have become potential risk with impact on air, waste, soil and public health (Veselaj *et al*, 2013).

Material and Methods

Characteristics of the Landfill

The sanitary landfill of the Solid Waste Management for the Peja region is situated in the location of Sferka (Figure 1). This landfill serves for landfilling of waste collected from municipalities: Peja, Decan, Junik, Istog and Klina. The information in the Table 1 shows that population covered by the waste collection service in the region represents 61.2%, (or 138.1260 inhabitants) of the population of the region (MLGA, 2016). Figure 2 shows the map of the sanitary landfill in Sferka, where the solid waste of Peja region is deposited. The waste landfilling process in the sanitary landfill had been started at the beginning of 2001.

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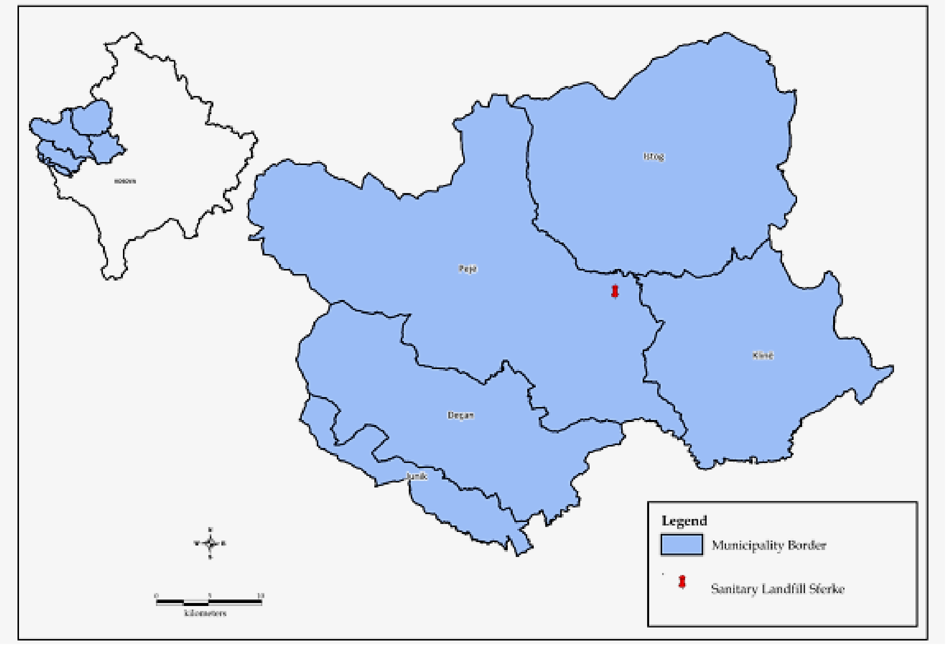

Figure 11. Map of the Peja Region and its position within Kosovo

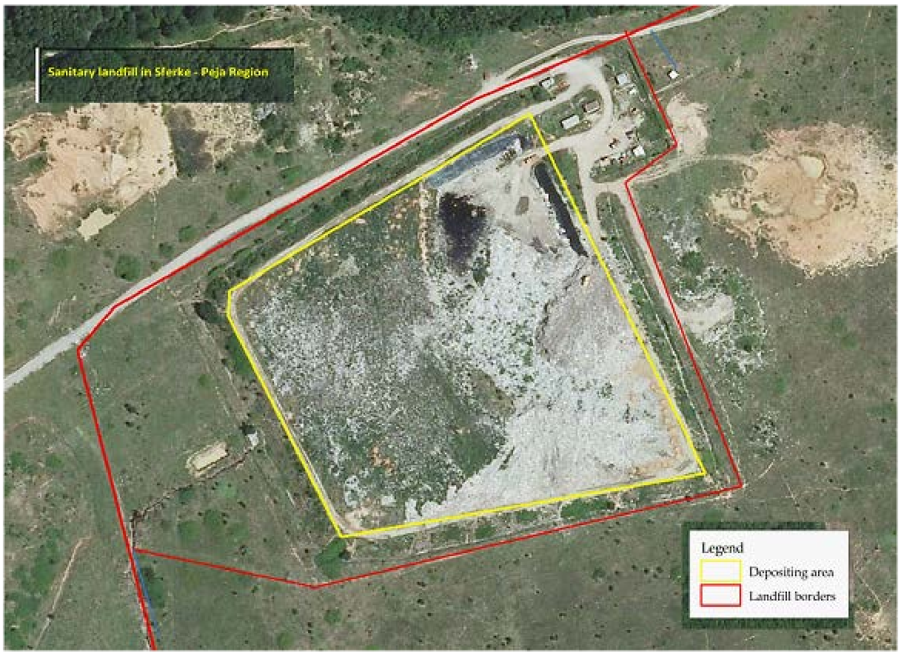

Figure 2. Sanitary landfill of the Peja region

Table 1. Number of population covered with waste service collection in the Peja Region

Name of Regional sanitary landfill	Region	Municipalities	Area of municipality km^2	Nr. of population	% of population covered by the waste collection service	Nr. of population covered by the waste collection service
Sanitary landfill in Sferka	Peja Region	Peja	603	97890	87%	85164
		Junik	78	6382	58%	3702
		Decan	294	41173	22%	9058
		Istog	454	39604	53%	20990
		Klina	309	39208	49%	19212
	Total		1738	224257	62%	138126

The landfill sifted with a PE-foil sealing layer. The total area of landfill is about 5 ha. The waste landfilling area has a size of about 3.5 ha. Due to the shallow pit structure there is a homogeny waste filling height in all deposition zones. The average waste height is estimated about 11 m. There is no adequate equipment for active degassing of the landfill. The waste deposition process should be continued at least up to the year 2020 (KEPA, 2015). The characteristics of the sanitary landfill in Sferka are presented in Table 2.

Table 21. Characteristics of Sanitary landfill in Sferka

Starting year of operation	Type of landfill	Status of landfill	Area of landfill	Waste depositing area	Maximal height of waste	Total deposited waste until 2016 tons	Waste deposition is planned up to the year
2001	Managed semi-aerobic	Current use	5 ha	3.5 ha	11 m	341,062	2020

Climate Conditions Prevailing in the Peja Region

Sferka sanitary landfill is located in Peja region, which is characterized by a prevailing continental climate with 744 mm/yr of rainfalls. The coolest months are December and January. The driest months are Jun and July (KHMI, 2018). Figure 3 shows the climate conditions in the Peja Region for the years 2006-2016.

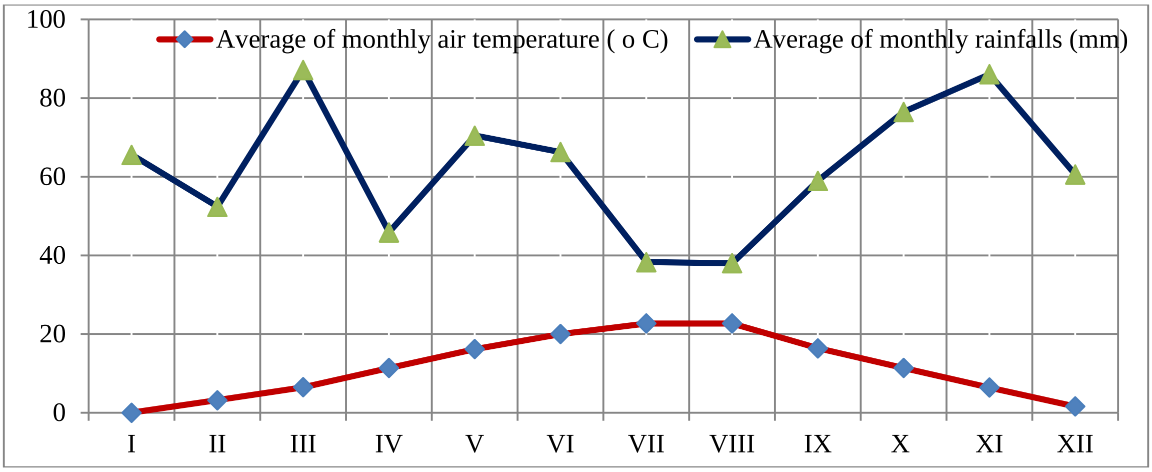

Figure 3. Climate conditions in the Peja region 2006-2016

Quantification of CH_4 emission

Calculation of CH_4 emission from the landfill in Sferka was based on data on the landfilled waste for the interval 2006–2016. The estimation of the CH_4 emission from the landfill was carried out by means of empirical calculation according to the IPCC recommendations (IPCC 2006).

The IPCC default method for estimation of methane emission from waste disposal sites is based on the following equation:

Methane emissions = (MSWT*MSWF*MCF*DOC*DOCF *F*16/12-R)*(1-OX)

Where:

MSWT = Total amount of generated waste (Gg/year)
MSWF = Fraction of disposed waste
MCF = Correction factor of waste fraction that generates methane gas for the sanitary landfill.
DOC = Fraction of biodegradable organic carbon
DOCF = Fraction of biodegradable organic carbon that is readily available for degradation
F = Fraction of methane in biogas.
OX = Fraction of methane gas that is oxidized to carbon dioxide.
R = Recovered CH_4 (Gg/yr)

To perform the emission calculations over the years 2006–2016, annual data on waste disposal and composition of waste deposited into the sanitary landfills were collected from the Kosovo

Environmental Protection Agency and, Statistical Agency of Kosovo and municipalities of the region. Calculation of the emissions were based on the IPCC 2006 model spreadsheet, as described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The specific parameters and values according to IPCC method applied for estimation of CH_4 emissions from Sferka landfill are presented in table 3. The projected emissions for the years 2017-2022 were calculated based on the projected waste disposal into the sanitary landfills and the projected population growth.

Table 3. Parameters according to IPCC 2006 default value used for the sanitary landfill

Parameters		Value
DOC (Degradable organic carbon) (weight fraction, wet basis) Waste by composition	Food waste	0.15
	Garden	0.2
	Paper	0.4
	Wood and straw	0.43
	Textiles	0.24
	Disposable nappies	0.24
DOCf (fraction of DOC dissimilated)		0.5
Methane generation rate constant (k) (years^{-1})	Food waste	0.185
	Garden	0.1
	Paper	0.06
	Wood and straw	0.03
	Textiles	0.06
	Disposable nappies	0.1
Delay time (months)		6
Fraction of methane (F) in developed gas		0.5
Conversion factor, C to CH_4		1.33
Oxidation factor (OX)		0
Methane Correction Factor (MCF) for managed semi-anaerobic landfills		0.5

Results and Discussion

Disposal of wastes

The yearly amount of deposited waste in the sanitary landfill in Sferka amounted about 45,200 tons in 2016. About 341,062 tons of waste was deposited wastes from 2006 up to the year 2016. The table 4 shows the waste deposition to the sanitary landfill for Peja region during the time period 2006 – 2016 (KEPA, 2015) (KSA, 2016).

Table 4. Waste disposals in the sanitary landfill in Sferka

Nr.	Year	Waste disposal per year/tons	Accumulative waste disposed (tons)
1	2006	19,900	19,900
2	2007	20,300	40,200
3	2008	22,362	62,562
4	2009	24,000	86,562
5	2010	26,500	113,062
6	2011	30,300	143,362
7	2012	32,600	175,962
8	2013	36,500	212,462
9	2014	39,000	251,462
10	2015	44,400	295,862
11	2016	45,200	341,062

Waste Composition in Peja Region

Analysis of waste compositing for municipalities of the Peja region, estimated food waste with 36 %, paper and cardboard waste 13%, garden 5% wood 3% and textiles and rubbers 5% (MESP, 2018) (Figure 4).

Calculation of CH_4 emission

Calculations of the CH_4 emissions from the sanitary landfill in Sferka, during 2006–2016 are presented in the figure 5. The total mass of CH_4 generated in the landfill during 2006–2016 amounted to 8 Gg, or 200 Gg CO_2 equivalents (eq). The calculations of the projections of CH_4 emissions from the landfilled waste for the years 2017–2022 are presented in the figure 6. The total mass of CH_4 for the time period 2017–2022 was projected to amount to 13 Gg, or 325 Gg CO_2 eq.

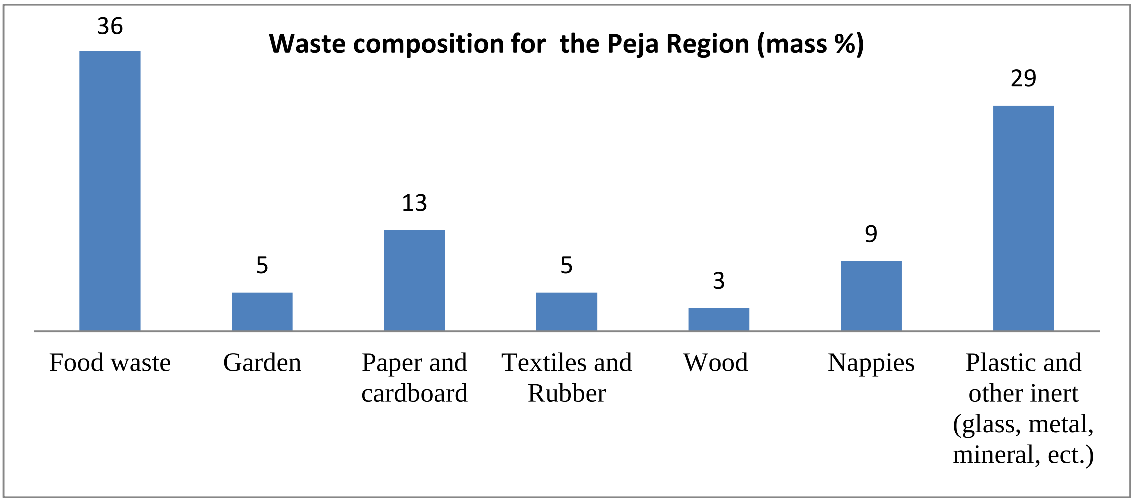

Figure 4. Waste composition for the Peja Region (mass %)

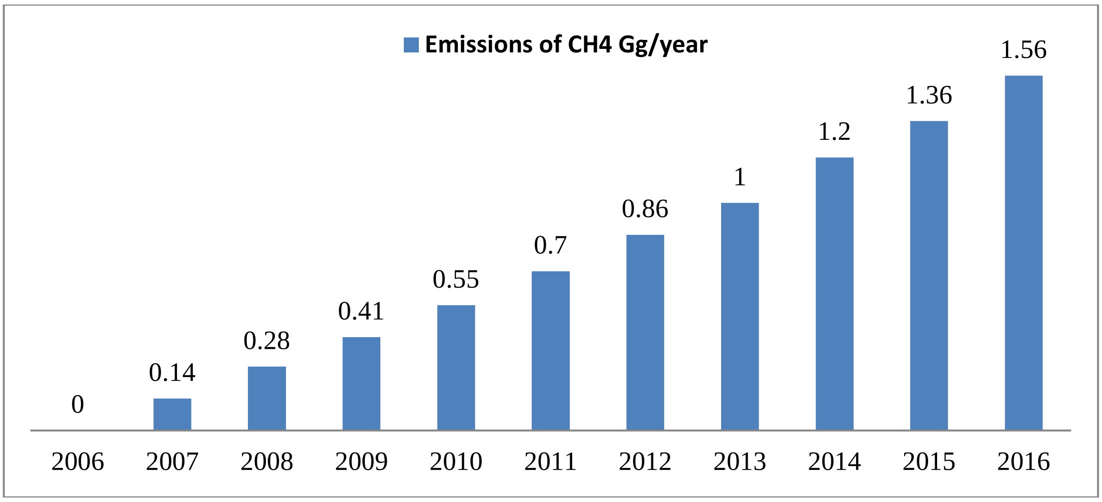

Figure 52. CH_4 emissions from the sanitary landfill Sferka 2006-2016 Gg/yr

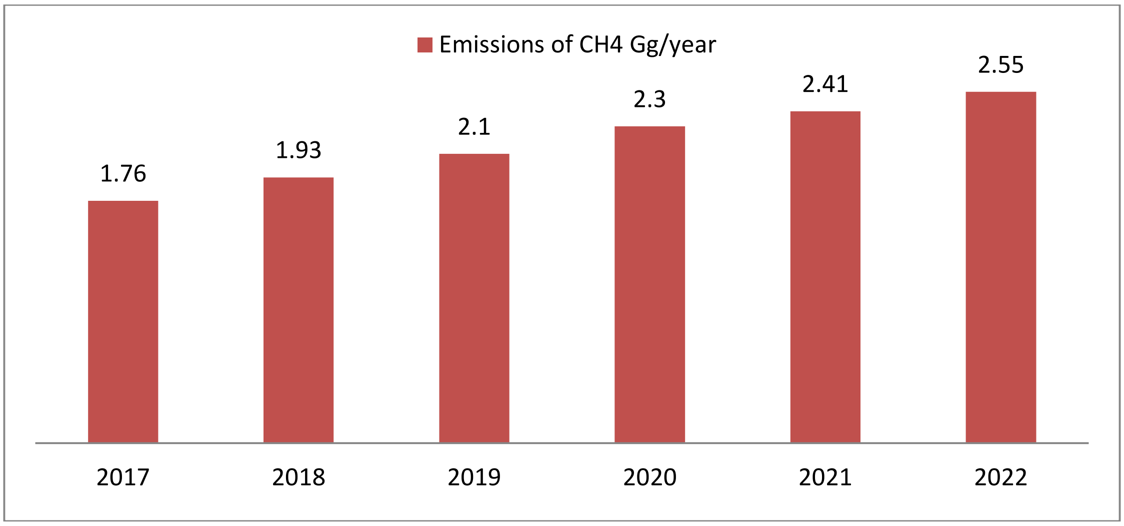

Figure 6. Projections of CH_4 emissions from the sanitary landfill Sferka 2017-2022 Gg/yr

Conclusions

GHG accounting and reporting in waste landfilling is of crucial importance as landfill is still the most common waste disposal method world-wide. The CH_4 emissions from sanitary landfill Sferka have been estimated individually according to specific information of the region (waste composition, climate conditions, landfills characteristics, amount of waste disposal, and other specific parameters) influencing the emission factors for landfills in accordance with IPCC 2006 are used instead of the most of the other studies, which was based only in the data on national level. The results of the study are important information which can be used for the development of country specific emissions factor for estimation of the methane emissions from waste disposal category. The mitigation of GHG emissions from waste disposal in the Peja region must be addressed in the context of integrated waste management and implementation of standards that require or encourage landfill CH_4 recovery and a reduction in the quantity of biodegradable waste that is landfilled.

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