Survey findings to study the socio-environmental and economic impact of MSW leachate on neighboring residents

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Abstract

The municipal solid waste leachate is harmful effluent, generated from mixed solid waste due to its moisture content. It contains organic compounds, heavy metals, nitrogen compounds, salts which percolates to the surface and contaminate ground as well as surface water. The current study was designed to understand the socio-economic and environmental impact of leachate on its neighborhood. The set of questionnaire was framed with questions on "Effect of Leachate" and their responses were recorded in five pointers as per Likert scale. The 99% of confidence interval was maintained in current study. The results rejected null hypothesis i.e. "no adverse impact of leachate presence near my residence" with acceptance of alternative hypothesis i.e. "adverse impact on the quality of life due to presence of leachate near my residence". Result showed that the leachate has negative impact on health; degradation of surrounding environment with loss of social and financial status of individual.

Keywords: Chi Square Test, Health impact, MSW Dumpsite, MSW leachate, Survey

1. Introduction

The aim of study was to focus on the findings from the survey on Leachate generation and its impact on human life near to residential colony at Ghazipur dumpsite area. Leachate is a liquid which seeps through waste dump and contaminate ground and surface water (MoEF 2016) and soil. It also mixes with potable ground water source. It is highly toxic in nature containing heavy metals, nitrogen compound, salts and organic matters (Keenan et al. 1984). The nature of leachate is dynamic and its toxicity varies from place to place primarily due to socio-economic diversity (Nagwekar 2014) and seasonal variations.

The survey was conducted to increase the awareness among the people on the negativity of presence of leachate near to their society and over human being. Through this survey the analysis of the behavioral, environmental and economical aspects of people living in the vicinity of Ghazipur dumpsite, Delhi, India area was done with respect to the impact of leachate. The Chi Square test was performed on the collected data for hypothesis testing. In all the questions a respondents were asked on the impact of leachate and hence the data redundancy as well as their consistency were checked and controlled. The redundant data were neglected from our analysis to avoid the biasness of the data. Most of the responses were recorded

distinct response i.e. either agreeing or disagreeing to the questionnaire and very few were recorded neutral which may lead to biased data.

2. Methodology

A survey has been conducted to evaluate the impact of MSW leachate on surrounding environment and residents near the dumpsite. 100 people residing near the MSW landfill site, Ghazipur, Delhi, India were surveyed and their responses were analyzed to measure the overall impact of leachate stream on their lives. The data collected from the questionnaire was Ordinal data which reflect the behavior or opinion of respondents on five pointer non-parametric Likert scale from being strongly agree to strongly disagree (Allen and Seaman 2007). To remove the biasness or redundancy in data, the 5 pointer non-parametric responses were limited to two responses "Agree" and "Disagree" by clubbing strongly agree with "Agree" and strongly disagree with "Disagree". A Chi square test was performed on the data with the general understanding that of "the presence of leachate is not impacting negatively to respondents"

The questionnaire was prepared to test the impact in the respondent's life due to presence of leachate near their habitat (Supplementary table 1). The approach was to ask the same question in a multiple ways to ensure genuine sample responses while filling the survey form (Pirkle et al. 1996). The impact of leachate stream in the locality was identified and the questionnaire was carefully drafted to avoid biasness in the responses. The impact of leachate on the health, environment, social status and economic value of property were studied in the current survey, which are directly affecting due to presence of MSW leachate.

3. Hypothesis testing

In current study, null hypothesis showed that the leachate stream generated in the dumpsite will have no adversity due to presence of leachate near their locality with nil impact on the health, environment social status and economic loss. An alternative hypothesis was also designed which determined that the presence of leachate effect the quality of life of respondents. The observations from respondents were taken and the hypothesis testing was conducted to find out which hypothesis statement has been supported by the collected data. As per,

Null hypothesis	H_0	No adversity due to presence of leachate near my residence
Alternative hypothesis	H_1	Adverse effect due to presence of leachate

The data collected by manual survey, hypothesis testing was performed by Chi Square test (Satorra and Bentler 2001). As per Chi Square test, the confidence level for testing the hypothesis is taken at 99%. Hence, the level of significance is 0.01 or 1%. It means that, if the outcome of Chi square test is less than 0.01 then we have sufficient evidences to reject the Null hypothesis and accept the alternate hypothesis. If the outcome of Chi Square test is more than 0.01, then we do not have enough evidences and do not reject the null hypothesis at present and reject the alternative hypothesis. Thus by choosing level of significance

at 1%, we have significantly reduce the chance of Type 1 error of "rejecting the null hypothesis when it is true". The response received from the respondent is mentioned in table 1. In the entire questionnaire the Chi Square test outcome is limiting to "0" and hence we have sufficient evidence of rejecting the null hypothesis and accepting alternative hypothesis. The hypothesis testing is performed in MS Excel tool.**Table 1:** The results of hypothesis testing on the data of manual survey by Chi square test.

Questions	**Actual outcome**				**Expected outcome**		**Chi square static**
	Neutral	**Agree**	**Disagree**	**Response w/o neutral**	**Agree**	**Disagree**	
Economic loss	7	88	5	93	88.20	4.80	0.01
Health impact	5	84	11	95	90.10	4.90	8.01
Treatment of leachate	64	34	2	36	34.14	1.86	0.01
Presence of leachate	13	82	5	87	82.51	4.49	0.06
Infectious agents	8	92	0	92	87.26	4.74	5.00
Cleaning drive for leachate	25	69	6	75	71.13	3.87	1.24
Reduction on pollution after treatment	62	37	1	38	36.04	1.96	0.50
Mental and physical fatigue by leachate	10	89	1	90	85.36	4.64	3.01
Impact on surrounding environment	11	89	0	89	84.41	4.59	4.84
Leachate as a problem	19	80	1	81	76.82	4.18	2.55
Surface water pollution	15	82	3	85	80.62	4.38	0.46
River pollution	17	80	3	83	78.72	4.28	0.40
Surface water pollution	15	83	2	85	80.62	4.38	1.37
Hard to stay	17	79	4	83	78.72	4.28	0.02
Social boycott	25	68	7	75	71.13	3.87	2.67
Impact on natural plantation	26	73	1	74	70.18	3.82	2.19
Mental phobia	9	88	3	91	86.31	4.69	0.64
Higher risk of vector borne disease spread	23	72	5	77	73.03	3.97	0.28
Positive Impact	9	87	3	90	85.36	4.64	0.61
Financial loss	29	52	19	71	67.34	3.66	67.75
Total	**409**	**1508**	**82**	**1590**	**1508**	**82**	**101.63**

4. Results

Since, the outcome of Chi Square Testing, all of the 20 parameters are falling inside the Level of Significance, α<= 0.01.The degrees of freedom chosen was n = (no. of rows - 1) * (no. of columns - 1) i.e. (20-1) * (2-1) = 19. The Chi square value at level of significance is 36.19. Any Chi square value greater than 36.19 falls under the rejection region.

Since, the sum of Chi Square static from all of the 20 parameters is 101.63 which is greater than 36.19 and are falling under the rejection region "The Level of Significance, α <= 0.01". Hence, based on the results the alternative hypothesis was accepted and null hypothesis was rejected, which confirmed the negative impact of the leachate on the socioeconomic environment of the residents.

5. Conclusion

From the survey data analysis, it can be concluded that the presence of MSW leachate in the surrounding of residential area imparting direct negative impact in all the four aspects of human life. The results from the Chi Square Test were recorded less than 0.01. This result is significant enough to conclude that there is negative externality of the presence of leachate near to residence. Negative externalities include negative impact on health, environment degradation, loss of social status and loss of economic value of property. The results and finding clearly indicate that the overall impact of leachate is negative. However this subject, which should be a matter of great concern is being ignored by the government. Also when asked in the survey, 65% of the respondents have stated that there is no effort made to treat the MSW leachate stream near the landfill. This is an alarming condition because this will deteriorate the environment and increase risk of a health hazard.

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Conflict of Interest

Authors declare there is no conflict of interest.

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a. Strongly agree
b. Agree
c. Partially agree
d. Neutral
e. Partially disagree
f. Disagree
g. Strongly disagree

1. Leachate stream near my residence has caused depreciation of my property value.

Strongly agree Neutral Strongly disagree

a. b. c. d. e. f. g.

2. I and my family members fall sick often because of the presence of leachate stream around
a. b. c. d. e. f. g.

3. There is breeding of pathogens around the leachate stream
a. b. c. d. e. f. g.

4. I see government workers trying to clean up this stream often
a. b. c. d. e. f. g.

5. There is no worker who is cleaning up this system. It is lying as it is.
a. b. c. d. e. f. g.

6. The stream is treated chemically/biologically to reduce the pollution that it would otherwise cause
a. b. c. d. e. f. g.

7. A plant has been set up nearby to treat this stream
a. b. c. d. e. f. g.

8. This stream destroys the aesthetic look of our area
a. b. c. d. e. f. g.

9. There is a lot of bad odour created in our surroundings because of the presence of this leachate steam
   a. b. c. d. e. f. g.

10. This stream is a troublesome for the residents living in and around this area
    a. b. c. d. e. f. g.

11. I don't know if a leachate stream exists near my area
    a. b. c. d. e. f. g.

12. The potable water in my residence is polluted by this leachate
    a. b. c. d. e. f. g.

13. The potable water is blackish sometimes
    a. b. c. d. e. f. g.

14. The potable water is not clean in our area
    a. b. c. d. e. f. g.

15. Living in/around this area is a pain
    a. b. c. d. e. f. g.

16. My friends/relatives hesitate visiting us because of the leachate stream present nearby
    a. b. c. d. e. f. g.

17. There is no greenery in the around around
    a. b. c. d. e. f. g.

18. Growing crops in the soil in this area is inefficient process
    a. b. c. d. e. f. g.

19. I always have fear in my mind of falling sick because I live near a dumpsite
    a. b. c. d. e. f. g.

20. My life would have been calmer and peaceful if I lived far away from this dumpsite and leachate stream
    a. b. c. d. e. f. g.