Comparative Assessment of Kurukshetra City Waste Dumping Sites Using RIAM Analysis: A Case Study

Sanjeev Kumar and Surinder Deswal

Abstract Kurukshetra, a historical city in India, is dealing with major environmental issues regarding the final disposal of municipal solid waste (MSW). The waste of urban localities is directly dumped in the landfills situated in nearby villages. The selection of a new disposal site and technique also requires much attention. Environmental impact assessment or EIA is needed for establishing such waste management facilities for the city waste. The whole procedure of EIA is time-consuming, but it is urgent to consider all the different components affecting the environment. Rapid impact assessment matrix (RIAM) is a proven method to investigate and evaluate the physical, ecological, economic, and social-cultural impacts due to the developmental projects. The same tool is applied for the assessment of two different MSW landfill sites. Both of the disposal sites are on different stages of operations. Thus, analysis based on RIAM is used to find out the concerned areas which are affected due to dumping operations on these locations.

Keywords EIA · Sustainability · MSW · RIAM · Landfill

1 Introduction

Every developing nation is now dealing with issues of poor solid waste management. India is no exception, here, as both urban and rural cities are not doing well with the overall municipal solid waste (MSW) produced daily. Various factors are responsible for the considerable gap between the generation and collection of total MSW generated in India [1–3]. Urbanization, high consumer needs, lack of eco-friendly options, and lack of funds are some of the important reasons which need urgent attention. While suggesting and deciding the process of disposal of MSW, there is a need to address the issue of environmental impact assessment or EIA. The process of EIA is time-consuming, but it surely prevents the ill effects of such developmental projects [4–6]. EIA is being used in taking serious decisions regarding the type of project and

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A. K. Choudhary et al. (eds.), *Advances in Geo-Science and Geo-Structures*,
Lecture Notes in Civil Engineering 154,
https://doi.org/10.1007/978-981-16-1993-9_4

process required for MSW management. The EIA-2016 rules ask for serious actions if the guidelines are not met.

The process of EIA should be scientific and transparent as it involves prediction, identification, and mitigation of social, biophysical, and additional relevant effects of proposals [7]. Rapid impact assessment matrix which is also known as RIAM analysis has been successfully used to analyze a project in the least possible time [8]. This tool has been successfully used in various case studies [9, 10]. Among various rapid assessment techniques, RIAM methodology is helpful for fast and accurate analysis of specified components of EIA [11, 12].

The study targets the sanitary landfill sites of Kurukshetra which is an important city in Haryana, India. On average, the city generates 70 tons of MSW per day, and a single municipal corporation in Thanesar handles the collection, segregation, and disposal of this MSW. The collected waste is then directly dumped to the landfill sites which are situated at two different locations, in the outskirts of the city. One of the landfill sites is now non-operational, and the other landfill site is newly allotted in the village Muqimpura. Impact analysis of the selected disposal sites was done and compared by their impacts on specific areas. This study will be useful in creating awareness that is necessary while dealing with the issues of MSW management.

2 Methodology

2.1 Collection of Baseline Data

Site 1 is the old dumping site located at the village Mathana, and Site 2 is situated in the agricultural fields of Muqimpura village. A GIS-based analysis is used to identify the accurate locations of both the sites. Figure 1 depicts the location of these two sites.

- Site 1- Mathana Dumping Site (29.9802° N, 76.9542° E)
- Site 2- Muqimpura Dumping site (29.9815° N, 76.6730° E)

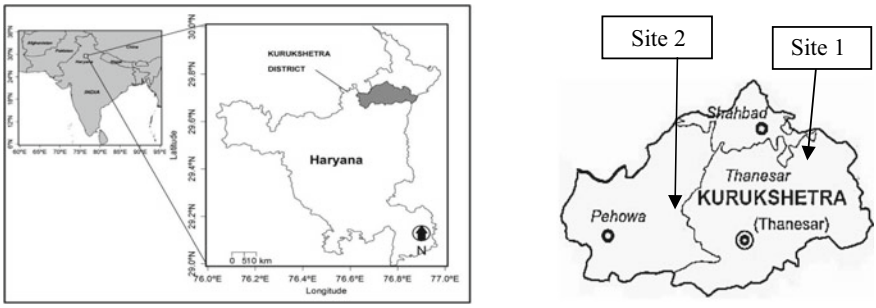

Fig. 1 Location of landfill sites

Site 1. Mathana dumping site (29.9802° N, 76.9542° E)
Site 2. Muqimpura dumping site (29.9815° N, 76.6730° E).

2.2 RIAM

To collect the responses, a team of 15 people from NIT Kurukshetra was formed to interact with the villagers. The team members are full-time students of the institute and are aware of the basic concepts and components of EIA and the role of MSW in environmental degradation. The overall evaluation of possible environmental impacts of disposal sites was done based on given points [13]:

1. Criteria A: have significance to the state and exclusively adequate to alter the obtained score.
2. Criteria B: significant to condition but independently incapable of altering the obtained score.

Selected individual components are then evaluated, and the environmental score or ES is calculated using the following equations (Tables 1 and 2).

Table 1 Evaluation criteria for RIAM

	Criteria	Scale	Description
A_1	Importance of condition	4	Important to national/international Interest
		3	Regional or national interests are related
		2	Significant to outside areas
		1	Only related to local conditions
A_2	Magnitude of change/effect	3	Major positive benefit
		2	Significant improvement
		1	Improvement in status quo
		0	No impact
		−1	Negative transformation
		−2	Substantial negative outcome
		−3	Major consequence
B_1	Permanence	1	Not applicable or neutral
		2	Provisional
B_2	Reversibility	1	Not applicable or neutral
		2	Changeable
		3	Unalterable
B_3	Cumulative	1	No developments or not applicable
		2	Single
		3	Synergistic

Table 2 Range bands for respective ES values

ES range values	RB codes	Explanation of RB
+72 to +108	E	Foremost positive impact
+36 to +71	D	Substantial optimistic impact
+19 to +35	C	Temperate positive impact
+10 to +18	B	Constructive impact
+1 to +9	A	Slightly optimistic impact
0	N	Neutral/not valid
−1 to −9	−A	Slightly negative impact
−10 to −18	−B	Negative impact
−19 to −35	−C	Temperate adverse impact
−36 to −71	−D	Substantial adverse impact
−72 to −108	−E	Major consequence

$$A_1 \times A_2 = A_T \tag{1}$$

$$B_1 + B_2 + B_3 = B_T \tag{2}$$

$$A_T \times B_T = \text{ES} \tag{3}$$

2.3 Analysis Using Rapid Impact Assessment Matrix

Data were collected in the form of answers to the questionnaire prepared from the people living in the vicinity. Questions based on different environmental aspects were considered by keeping the following vital areas in mind.

1. PC: physical and chemical components
2. BE: biological and ecological components
3. SC: sociological and cultural components
4. EO: economical and operational components.

To conduct this study systematically and scientifically, the mentioned components were further divided into subcomponents. The included subcomponents are as follows:

Physical/chemical components

- PC1 Proximity to human settlement
- PC2 Land recommendation
- PC3 Proximity to the water body
- PC4 Impact on surface water
- PC5 Odor emissions

- PC6 Soil fertility
- PC7 Groundwater pollution
- PC8 Landscape and topography
- PC9 Quality of affected land
- PC10 Closeness to the forest area.

Biological/ecological components

- BE1 Greenhouse gases emissions
- BE2 Impact on health of the soil
- BE3 Ecological risks due to chemicals in use
- BE4 Impact on nearby forest cover
- BE5 Forest cover for CO_2 sink
- BE6 Land pollution
- BE7 Impact on biodiversity and wildlife
- BE8 Implication on human well-being.

Sociological/cultural components

- SC1 Risk of communicable ailments
- SC2 Trouble due to dust emissions
- SC3 Trouble due to odor emission
- SC4 Noise pollution due to operation
- SC5 Disturbance to the community
- SC6 Public acceptance
- SC7 Implications due to site operation.

Economical/operational components

- EO1 Economic impact on agriculture land
- EO2 Water treatment cost
- EO3 Cost of land development
- EO4 Financial gains.

3 Result and Discussions

Open dumping is a common practice used by authorities to get rid of MSW, and hence, the lack of proper facilities is a cause of concern for both the sites. The following are the important results of this assessment:

1. Although Site 1 is now officially closed, its negative impacts on PC and BE components are very much similar to Site 2.
2. The newly allotted land in Site 2 is now a significant source of income to its owners, and it also creates jobs for the people living in the locality; but in the case of Site 1, the dumping site is not generating revenue anymore.

3. The emission of GHG, leachate collection, and odor control are the major unaddressed issues for both of these sites as these unplanned landfill sites have no provision for collecting and controlling these liquids and gases.
4. Comparing the ES scores and RB's confirms that the soil and water pollution in the area is a big concern for the environment at both the locations.
5. The SC and BE components for both the sites have no positive RB values. It interprets that both the sites have no positive contribution to these components and the negative RB values imply potential damage caused to these components.
6. The results mentioned in Figs. 2 and 3 depict that both the landfill sites are

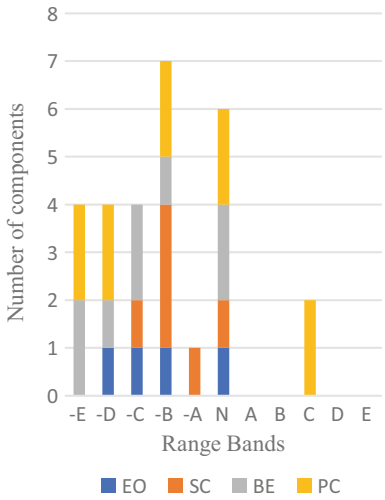

Fig. 2 RIAM analysis of Site 1

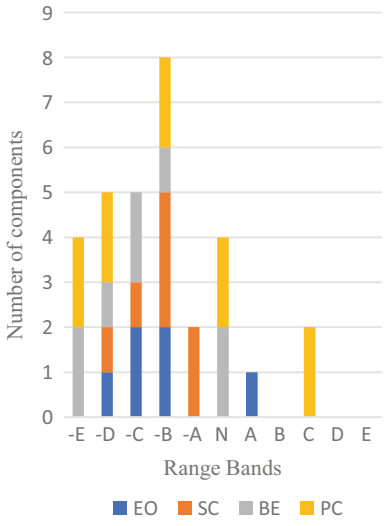

Fig. 3 RIAM analysis of Site 2

not environmentally sound. There is an urgent need to opt for better disposal techniques.

7. The study suggests that both the landfill sites are not sustainable. The authorities are deciding in a haste, and it is advised that the dumping sites be relocated to another location. A proper impact assessment of new disposal sites can help to avoid environmental damage.
8. As most of the collected MSW are wet and biodegradable, therefore, the direct disposal should be prohibited. Other modes of disposal are required depending upon the type of organic content and the availability of land and manpower.

4 Conclusion

The study of both these disposal sites suggests that open dumping of MSW in nearby village areas is not a sustainable solution. The final obtained range bands are almost identical which confirms that Site 2 will meet the same fate as Site 1. The final assessment using RIAM suggests that both these dumping locations need urgent attention from the authorities and the people living nearby. The study suggests the implication of vermicomposting and other bioconversion techniques will help to reach the sustainable aim of MSW management. RIAM can further be used for analyzing the future impacts of such facilities to make the decisions in record time. RIAM cannot be a shortcut to the whole EIA process, but it surely can contribute as a major tool for such impact assessments by the authorities and the decision-makers.

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