



# A hybrid multi-criteria decision making method approach for selecting a sustainable location of healthcare waste disposal facility



Ankur Chauhan<sup>\*</sup>, Amol Singh

Department of Operations Management, Indian Institute of Management Rohtak, MD University Campus, Rohtak, Haryana, 124001, India

## ARTICLE INFO

### Article history:

Received 13 May 2016

Received in revised form

19 August 2016

Accepted 20 August 2016

Available online 27 August 2016

### Keywords:

Healthcare waste management

Multi criteria decision making

ISM

Fuzzy set theory

AHP

TOPSIS

## ABSTRACT

Sustainability is the concern of organisations across the world; it has received attention of researchers from different fields including operations management. For addressing sustainability, the triple bottom line approach of environmental, societal, and economic sustainability has been widely mentioned in the literature. Since, the nature of healthcare waste is hazardous and infectious for environment and society; therefore, the careful disposal of this waste becomes an essential task for waste disposal firms. Along with this, the stringent guideline of world health organisation as well as National and State policies regarding the disposal of healthcare waste makes it a typical to do business. Therefore, to make it sustainable and affordable, in the present study the criteria related to the sustainability's triple bottom line, including other criteria, have been identified from literature review and field survey for the selection of a sustainable location of healthcare waste disposal facility. Moreover, a hybrid method of interpretive structural modelling, fuzzy analytic hierarchy process, and fuzzy technique for order preference and similarity to ideal solution has been used to carry out this study. Therefore, the present work makes the theoretical, in terms of criteria, as well as methodological contribution, hybrid method, for the selection of a sustainable location of healthcare waste disposal facility.

© 2016 Elsevier Ltd. All rights reserved.

## 1. Introduction

In the last four decades the population across the world has increased rapidly, especially in developing countries. The rapid increase in population has created numerous problems which have severe impact on the health of humans and animals. One such problem is the disposal of huge quantities of healthcare waste (HCW) which comes from clinics, pathology labs, nursing homes, and hospitals; this waste include syringes, blooded cottons, bandages, scalpels, body parts, chemicals, cytotoxic, and radioactive elements (Pruss, 2014; WHO, 2013).

Since, healthcare waste consist of harmful components; therefore, it has been categorised under hazardous and infectious wastes by different environmental bodies and researchers across the world (O'leary et al., 2002; Pruss et al., 1999; SBC, 2013). The bio-medical waste, management and handling, rules vividly states that the collection and disposal of healthcare waste should be carried out with the help of a licenced healthcare waste disposal firm (MOEF, 2016; The Gazette of India (1998)). The healthcare waste disposal

firm collects the waste from different hospitals in its region, such as Mandawar Pollution Control Committee (MPCC) which is a waste disposal firm in Uttarakhand; it collects the waste from more than 400 clinics, pathology labs, and hospitals. Additionally, the amount of healthcare waste collected for treatment and disposal is increasing rapidly (IndiaStat, 2013); therefore, the HCW disposal firm has to select a sustainable location to establish a facility for daily storage, treatment and disposal of healthcare waste (Chauhan and Singh, in press).

The facility location problems have been studied in the areas such as supply chain management which addresses the issues regarding determination of a company's manufacturing, warehouse, and distribution centre location (Almeida et al., 2013; Ertugrul and Karakasoglu, 2008; Melo et al., 2009). Few more examples include the decision about the location of a hospital, location of waste collection bins in a hospital campus, etc. (Andrinopoulos et al., 2016; Melo et al., 2009; Nolz et al., 2014). Ertugrul and Karakasoglu (2008) described in their study that the facility location problem is multi-criteria in nature and it depends on some basic criteria such as availability of labour. However, in case of a hazardous and infectious waste such as HCW, it cannot be limited to some basic criteria. The consideration of the criteria apart from basic criteria, to select a location for the establishment of a healthcare waste disposal facility, would facilitate the decision

<sup>\*</sup> Corresponding author.

E-mail addresses: [chauhan.ankur2903@gmail.com](mailto:chauhan.ankur2903@gmail.com) (A. Chauhan), [amolasingh2007@rediffmail.com](mailto:amolasingh2007@rediffmail.com) (A. Singh).

makers to achieve an environmentally, socially, and economically, sustainable location (Ertugrul and Karakasoglu, 2008; Govindan et al., 2013; Porter and Kramer, 2007).

The evolution of sustainability issues among organisations may be attributed to the depletion of natural resources, lack of stringent legislations, and poor support of the managers in sustainable decision making (Calabrese et al., 2016; Govindan et al., 2013; Hart and Milstein, 2003). However, Dao et al. (2011) mentioned sustainability as an essential factor for long-term development and growth of a company which encourages the management researchers and practitioners for working upon the issues such as the selection of a sustainable location for healthcare waste disposal facility. Since, the selection of a sustainable location is a multi-criteria decision making problem of multi-attribute decision making type which has been discussed ahead, in Section 2. The application of hybrid method would help in identifying a sustainable location for healthcare waste disposal. The selection of a sustainable location would be beneficial for healthcare waste disposal firm, society, and environment, i.e. in terms of business, less exposure to public, and the reduction the usage of natural resources such as land, water and carbon emissions, respectively. Moreover, the hybrid method has been applied on the eight criteria identified from literature review and field survey.

The rest of the paper has been organised as follows: The hybrid method of interpretive structural modelling (ISM), fuzzy analytic hierarchy process (AHP), and fuzzy techniques for order preference and similarity to ideal solution (TOPSIS) has been given in Section 3 i.e. Research methods. The application of the hybrid method would help in the achievement of a better solution with less complexity (Beikkhakhian et al., 2015a). Areal case study from India has been detailed to apply the hybrid MCDM approach in Section 4. The results and discussions of the case study have been given in Section 5. The conclusion of the study has been given in Section 6. The implications of the study have been provided in Section 7. Section 8 details the limitations and future research directions.

## 2. Literature review of the facility location problems and criteria identification

From the recent literature reviews regarding facility location problems it has been observed that most of the problems under location science have been discussed in multi-criteria decision making (MCDM) environment (Farahani et al., 2010; Melo et al., 2009). The MCDM problems have been noticed as the combination of multi objective decision making (MODM) and multi attribute decision making (MADM). The MODM problems are such that it tries to develop the best alternative with the help of a set of

quantifiable objectives, well defined constraints, and trade off information (Farahani et al., 2010). The studies which have been conducted to address the issue of waste disposal facility location majorly consider the multi-objective decision making techniques such as linear programming (Alumur and Kara, 2007; Rakas et al., 2004).

In contrast to the MODM problems, the MADM problems have a few numbers of predetermined alternatives. In MADM problems the alternatives satisfy a specified level of objectives and the decision makers are supposed to choose the best alternative. Moreover, in the literature, the application of MADM techniques have been considered as an important method to solve facility location problems for addressing the sustainability issues such as societal (Ertugrul and Karakasoglu, 2008; Farahani et al., 2010; Kahraman et al., 2003b; Melo et al., 2009). Kahraman et al. (2003b) applied the fuzzy analytic hierarchy process method to address the problem of choosing a location for the establishment of a motor company.

Multi-objective decision making problems can be single criteria or multiple criteria, however, the multi-attribute decision making problems are based on multiple criteria only (Farahani et al., 2010). Since, the present study is an MCDM problem of MADM type which has been carried out to address the issue of selection of a sustainable location for healthcare waste disposal facility establishment; therefore, the multiple criteria have been identified from literature review and field survey. The study conducted by Ertugrul and Karakasoglu (2008) described the general multiple criteria involved in the selection of a location of a facility i.e. distance to markets, distance to resources (raw material), people engagement (interest) for facility establishment, and facilities provided to working staff. Additionally, Farahani et al. (2010) carried out the review of literature on facility location problems and described the various multiple criteria involved in the decision making as cost; product value; risks to environment such as sound pollution, air or water pollution, smells; utilization of facility and accessibility to resources; completion; political matters and legal regulations. However, there is no specific study which could be reviewed for the identification of criteria of healthcare waste disposal facility location.

As described previously, the sustainability decisions are mainly based on environmental, societal, and economic dimensions. In this study, the environmental sustainability included the technology for treatment and disposal, final disposal method of ashes, water usage, etc. For economic sustainability, the cost of installation and maintenance of machines, cost of transportation, labour cost, and fuel cost, etc. And the societal sustainability the criteria included the exposure of healthcare waste disposal facility to public, health of workers, the quantity of healthcare waste for disposal, area

**Table 1**  
The detailed description of each criterion.

S.No.	Criteria	Explanation of criteria	Reference
1	Distance ( $C_1$ )	Distance of waste disposal facility from waste collection point	(Erkut and Susan, 1989), (Ioannis, 1998), (Ertugrul and Karakasoglu, 2008) Field survey
2	Waste disposal site exposure to public ( $C_2$ )	The proximity of waste disposal site to population	
3	Availability of land ( $C_3$ )	Availability of land (landfilling space) for disposal of healthcare waste	(Erkut et al., 2008),
4	Cost ( $C_4$ )	Cost of transportation of HCW to disposal facility	(Rakas et al., 2004), (Arvind and S.K., 1999)
5	Sensitivity towards environment ( $C_5$ )	The environmental friendliness of a facility location in terms of land usage, water, air, and emissions, etc.	(Alumur and Kara, 2007), (Kumar et al., 2008), (Erkut et al., 2008),
6	Quantity of HCW for disposal ( $C_6$ )	The weight or quantity of HCW for final disposal	Field survey
7	Area covered by HCW disposal site ( $C_7$ )	The area dedicated to a particular HCW disposal facility	(Cohon, 2013)
8	Road condition ( $C_8$ )	The connectivity of Healthcare waste collection point to HCW disposal facility. The poor condition of road leads to more carbon emission, poor mileage, and high cost.	(Cantarella and Vitetta, 2006)

Download English Version:

<https://daneshyari.com/en/article/8100719>

Download Persian Version:

<https://daneshyari.com/article/8100719>

[Daneshyari.com](https://daneshyari.com)