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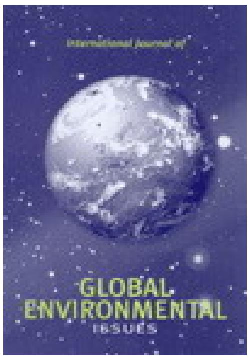

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Site selection for landfills using GIS-based multi-criteria decision analysis – a case study of National Capital Territory of Delhi, India

Amrapali Tiwari, G. Sreenivasan, Vinod Kumar Sharma

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Site selection for landfills using GIS-based multi-criteria decision analysis – a case study of National Capital Territory of Delhi, India

Amrapali Tiwari*

Indian Institute of Remote Sensing,
Dehradun, India
Email: amrapalitiwari61294@gmail.com
*Corresponding author

G. Sreenivasan

Regional Remote Sensing Centre – Central,
NRSC, ISRO,
Nagpur, India
Email: sreenivasan_g@nrsc.gov.in

Vinod Kumar Sharma

Regional Remote Sensing Centre – North,
NRSC, ISRO,
New Delhi, India
Email: vinod_sharma@nrsc.gov.in

Abstract: Landfill site selection in an urban area like National Capital Territory (NCT) of Delhi is a challenging task due to shortage of suitable land and other environmental, economic and social parameters. This study focusses on the utilisation of geographic information system, open-source libraries and remote sensing for identification of potential landfill sites in Delhi NCT. Multi-criteria decision analysis (MCDA) and other GIS-based approaches are used for analysing various natural parameters derived using remote sensing satellite data products. Resourcesat LISS-III and Sentinel-2 multispectral satellite data is used for deriving the required parametric layers. Zones in the vicinity of monuments, transport, canals, drainages, lineaments are avoided altogether. Results reveal overall, most suitable places for landfill site in study area is around 4.05 sq. km (0.27%), moderately suitable places are 14.68 sq. km (0.98%), least suitable places are 25.46 sq. km (1.71%) and not suitable places is 1,419.11 sq. km (95.62%).

Keywords: geographic information system; GIS; multi-criteria decision analysis; MCDA; Geospatial Data Abstraction Library; GDAL; open-source libraries; Delhi NCT; remote sensing.

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Biographical notes: Amrapali Tiwari is a Senior Research Fellow at Indian Institute of Remote Sensing, Dehradun, India. She is pursuing her PhD from Birla Institute of Technology Mesra in Civil and Environment Engineering Department. She has completed her MSc in Environment Management from Guru Gobind Singh Indraprastha University New Delhi. Her field of expertise includes ecology and environment management, biodiversity and wildlife conservation using geospatial techniques.

G. Sreenivasan is a Senior Scientist and Dy. General Manager at Regional Remote Sensing Centre (RRSC-C), National Remote Sensing Centre (ISRO), India. He received his Masters degree in Applied Geology, and PhD in Geology from Karnatak University, India. His fields of expertise include R&D in remote sensing and GIS for development of applications in the areas of natural resources management, sustainable development and infrastructure development for societal benefit, national development and e-governance. He has provided geospatial solutions through multi-criteria decision analysis and geospatial modelling for watershed management, mineral and groundwater exploration, land and water resources planning and other allied domains.

Vinod Kumar Sharma is a scientist in Regional Remote Sensing Centre-North of National Remote Sensing Centre (ISRO), India. He received his Masters degree in Information Systems from Netaji Subhas Institute of Technology, Delhi University, India and PhD in Geo Engineering from Andhra University, India. His field of expertise includes web-based geoinformatics, spatial DBMS, DSS/SDSS, Open-source GIS, mobile application development, automation, spatial analysis, and processing on web.

1 Introduction

National Capital Territory (NCT), Delhi of India has witnessed considerable growth in urban and built-up areas with an increased population growth rate in the last three decades (Mohan et al., 2020). NCT, Delhi, is being planned with the goal of sustainable urbanisation. However, the rapid growth has given rise to many problems, mainly an increase in solid waste generation (Kanawade et al., 2020). A large amount of solid waste generation needs to be taken seriously and should be tackled using scientific methods. Every day more than 9,500 tonnes of garbage are generated in Delhi NCT, out of which about 8,000 tonnes of garbage waste are dumped in landfill sites at Bhalswa, Okhla, and Ghazipur by the municipal corporation (Rani et al., 2020).

Different types of waste like kitchen waste, bio medical waste, and building construction waste are dumped into landfill sites and segregated using different means, some of which can be recycled (Glasser et al., 1991; Al-Salem et al., 2009; Mathur et al., 2012; Singh et al., 2014, 2017; Wang et al., 2018; Pereira et al., 2019). These sites extend to an area of about 1.5×10^3 km^2 and need to be extended further to cater to the future needs of solid waste disposal. According to NITI Aayog (a policy think tank of the Government of India), the population density of Delhi is 9,340 per sq. km and the waste generated is 9,500 tonnes per day (Sambyal, 2017). The responsibility for the management and handling of municipal solid waste comes under the jurisdiction of the Department of Urban Development and urban local bodies. At present, all the three landfill sites in Delhi are filled beyond their capacity and are supposed to be closed by

2010. Due to a lack of suitable places, corporations continue to dump garbage at these landfills. The constant increase in the population of the city is making the problem even more severe. Expansion of existing landfill sites is difficult, as new infrastructure is already constructed in the vicinity of these landfill sites. Therefore, there is a strong need to assess the available land in Delhi NCT and to identify the potential landfill sites for catering to the future solid waste disposal needs.

Landfills are the most common mode for the disposal of solid waste. It operates by layering waste in a large pit. Modern landfills, i.e., engineered landfills have scientific treatment facilities and follow municipal solid waste rules (Manuja et al., 2020). Selection of suitable sites for the creation of landfills and construction of landfills requires scientific analysis of the number of environmental, social, and aesthetic factors.

The present study focuses on the selection of landfill sites for the Delhi NCT region, based on the geographic information system (GIS) and multi-criteria decision analysis (MCDA) technique. The concept of MCDA divides decisions into smaller parts and seeks solutions after analysing each part separately, it then allows the integration of individual results for calculating the final result (Nas et al., 2010; Alkaradaghi et al., 2019; Sisay et al., 2020).

Landfill site selection by analysing major environmental parameters, terrain parameters, infrastructure (roads, railways), and hydrological networks through GIS operations, can be an efficient technique that pays attention to major parameters (Jerie and Zulu, 2017). Criteria analysis techniques (AHP) with weighted overlay analysis to has shown promising results in landfill site selection (Poorna and Vinod, 2016). MCDA along with weighted overlay has been used at different geographical locations for landfill site suitability (Alkaradaghi et al., 2019; Sisay et al., 2020). The inclusion of additional parameters like economic and social criteria can improve the site selection process but it makes the process more complex.

Overloading of the existing solid waste disposal sites in Delhi NCT, leading to an immediate demand for the identification of new waste disposal sites to cater to a large volume of waste generated by the growing population in the city, is the prime reason for carrying out this study. Delhi NCT has observed a many fold increase in urbanisation from 1970 to 2010, from 2.7% in 1972 to 59% in 2014 of the total area, resulting in 4.5 times increase in urban population since the 1970s (Mohan et al., 2020). As estimated, the population of New Delhi alone will be raising to 0.419 million in 2021 (Saha et al., 2020). The presently available landfill sites will not be able to fulfil the future requirement of Delhi NCT and new sites need to be identified fulfilling all the guidelines and criteria issued by the MoEF (2016), NEERI (1996) and CPCB (2001) for landfill site selection. Therefore, this study is crucial to address the need for the identification of potential landfill sites in Delhi NCT for fulfilling future waste disposal requirements.

2 Literature review

2.1 GIS-based MCDA

MCDA enables users to combine the information from several criteria to form a single index of evaluation, helping in making the best suitable choice among many criteria (Feizizadeh et al., 2014). Weighted sum and weighted product methods, multiple-criteria utility functions, elimination and choice expressing reality, program budgeting and marginal analysis, goal programming, analytical hierarchy process (AHP), and cost-benefit analysis are different methods used for MCDA (Achu et al., 2020). Integration of MCDA and GIS techniques improves the site suitability process by combining operations of overlay and buffer analysis on various datasets with a facility to prioritise different parameters based on criteria. MCDA-based modelling using geospatial techniques has been used extensively in solving several problems on potential sites identification, for example, suitable sites identification for water harvesting structures, identification of potential mineralised zones for specific valuable minerals, delineation of potential zones for groundwater, selection of suitable areas for wildlife protected areas, identification of sites for soil conservation, identification of sites for sewage treatment plants, etc. (Pendke et al., 2017; Vaissi and Sharifi, 2019; Sreenivasan et al., 2020; Srivastav et al., 2021). GIS-based MCDA technique is the ideal tool to resolve the landfill site selection problem due to the ability of GIS to manage huge bulks of spatial data from various sources, and MCDA provides a reliable ranking of the probable landfill areas based on a set of criteria and breaking of a problem into smaller parts (Barakat et al., 2017; Demesouka et al., 2019).

2.2 Open-source geospatial libraries and tools

Geospatial technologies cover a wide range of applications starting from traditional mapping to online data analysis systems, providing functionalities ranging from Geoprocessing libraries to complex GIS software suites (Sharma et al., 2017). The landfill site selection process demands analysis of different spatial parameters like land use land cover (LULC) layer, soil layer, slope layer, etc. As the input layers are collected from different sources for analysis, they may not be uniform in nature and cannot be used directly. Pre-processing of layers needs to be done to bring them to the same coordinate system and projection system. Usage of proprietary GIS software for performing the pre-processing and GIS operation is expensive and increases the overall cost of the work. Open-source spatial libraries like Geospatial Data Abstraction Library (GDAL), provide an abstract data model to read and write different geospatial raster and vector formats. It facilitates data processing using command-line utilities programmed in programming languages like C# on the .net platform. GDAL utilities like ‘gdalinfo’, ‘gdal_translate’, and ‘gdalwrap’ facilitate automating the spatial data transformation process. Hence, the present work utilises the open-source GDAL libraries for bringing the heterogeneous input spatial data collected from different resources in different formats and projections in a common format for performing GIS operations. The ready-to-use input layers are further analysed for identifying the probable landfill site selection using MCDA.

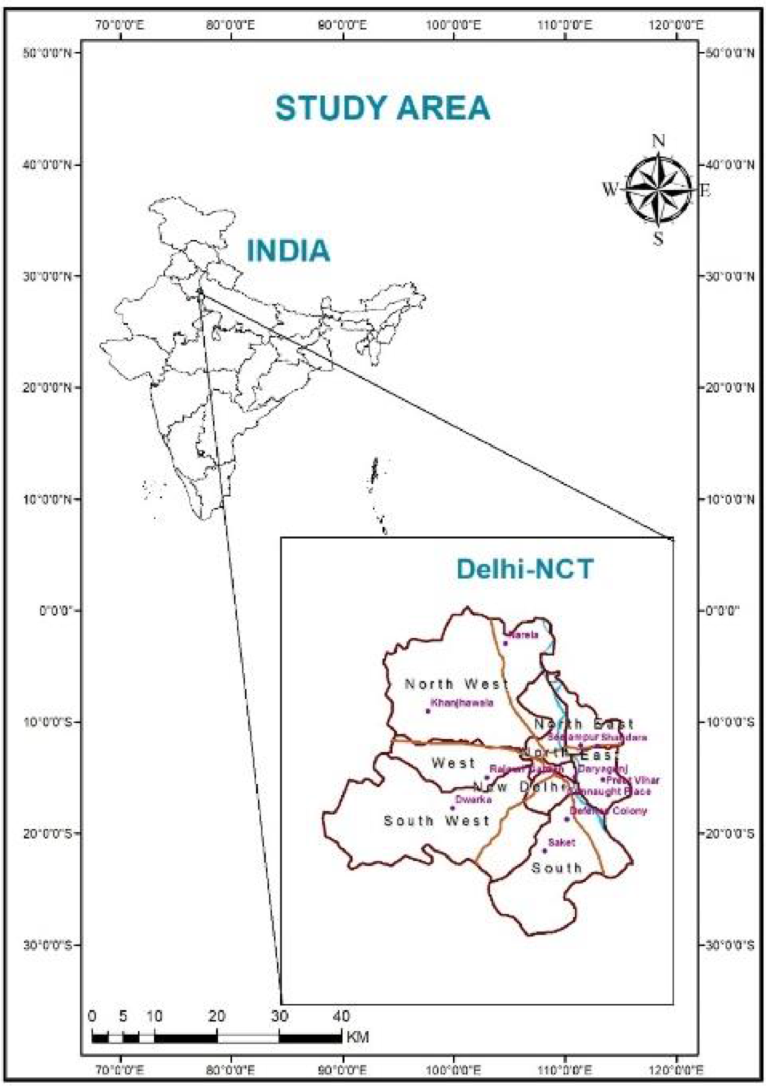
3 Methods and materials

3.1 Study area

The study area, Delhi NCT is geographically located at 28.7041°N, 77.1025°E, and lies in northern India (Figure 1). The NCT of Delhi is spread over an area of 1,484 km^2 of which 783 km^2 is designated as rural area and 700 km^2 as urban area. Delhi has a maximum length of 51.9 km and a maximum width of 48.48 km.

Delhi is having five municipal authorities responsible for municipal solid waste management in the respective areas of their jurisdiction. Ministry of Environment, Forests, and Climate Change revised the solid waste management rules in 2016 (MoEF, 2016). The responsibility of the management of municipal solid waste has been assigned to the urban development department and urban local bodies. There are three landfill sites in Delhi, namely, Ghazipur landfill site, Okhla landfill site, and Bhalswa landfill site. Ghazipur landfill site was commissioned in the year 1984, Bhalswa in 1994, and Okhla in 1996. All three of the landfills were supposed to be closed by now since they are filled beyond their capacity. Due to a lack of suitable places, corporations are continuing to dump garbage at these landfills' sites.

Figure 1 Study area location of Delhi NCT (see online version for colours)



3.2 Datasets

Resourcesat-2 LISS-III data is used for generating land use – land cover map of the study area, and further updated using the Sentinel-2A MSI data. Sentinel-2A MSI data is used for preparing the transport network, drainages, canals, and lineaments layers of the study area. Datasets from Sentinel-2 were downloaded from USGS earth explorer and datasets from Resourcesat-2 LISS-III were downloaded from the ISRO Bhuvan portal (NRSC, 2015). Both the datasets were pre-processed and brought into a common spatial and file format using GDAL. Functionalities namely 'gdal_translate' and 'gdalwrap' are used for generating geo-corrected spatial datasets in the '.tiff' file format. Further input spatial datasets were layer stacked and mosaiced using standard GIS software to obtain ready-to-use spatial datasets over a study area.

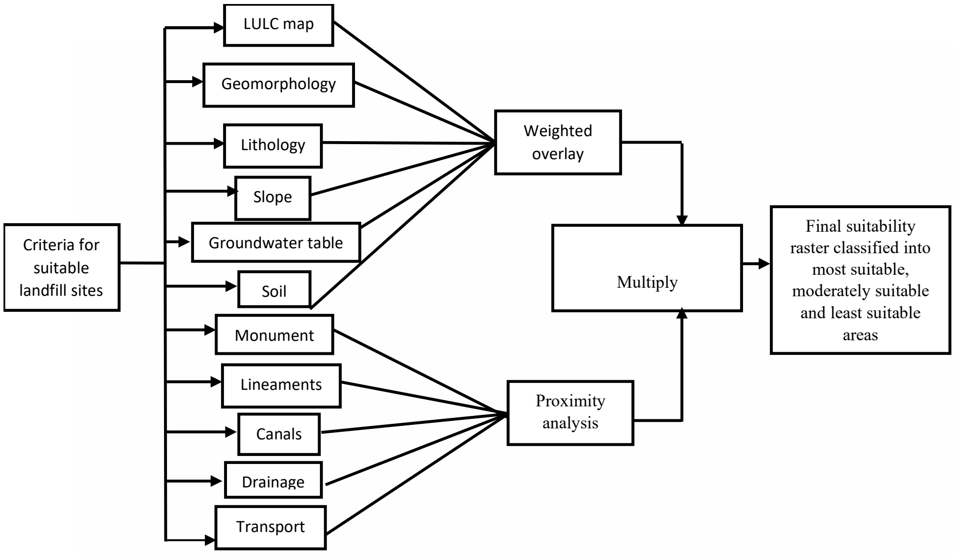
3.3 Processing

Classes containing the different criteria for identifying suitable landfill sites are generated based on the literature survey and also referring to the guidelines issued by MoEF (2016), NEERI (1996) and CPCB (2001) for landfill site selection. Multiple steps are executed to identify the suitable location for landfill site selection (Figure 2). Pre-processed satellite datasets of Resourcesat-2 and Sentinel-2 are used to prepare LULC and infrastructure layers. Other thematic layers namely, geomorphology, lithology, and soil are taken from existing sources and updated using the Sentinel-2 data. Geomorphology is modified after (Chatterjee et al., 2009), lithology is based on NRSC lithology data (https://bhuvan.nrsc.gov.in), and soil is based on National Bureau of Soil Survey and Land Use Planning (1979) data (https://www.nbsslup.in). The slope is derived from the digital elevation model of GMTED data (https://www.usgs.gov/core-science-systems/eros/coastal-changes-and-impacts/gmted 2010). The groundwater table map is sourced from Groundwater Year Book 2017–2018 of Delhi NCT (CGWB, 2019). Transport, water bodies, drainage, and lineaments were interpreted using Sentinel-2 satellite imagery. Coordinates for monuments were taken from https://www.latlong.net and the monuments layer has been generated in GIS using these coordinates. Updated thematic layers are used as input for performing the MCDA. The problem is decomposed into two sub-problems whose solution is obtained using weighted overlay and proximity analysis. Layers pertaining to LULC, geomorphology, lithology, slope, groundwater table, and soil were analysed by applying the weighted overlay. Proximity analysis is applied to the transport layer, drainage layer, canals layer, lineaments layer, and monument layer. The result obtained from the weighted overlay and proximity analysis is integrated to classify the information into most suitable, moderately suitable, and least suitable zones for landfills.

3.3.1 Weighted overlay analysis

Spatial layers pertaining to the groundwater table, LULC, geomorphology, lithology, slope, and soil are considered for applying weighted overlay analysis. Criteria with weights varying from 0 to 9 are assigned to each input layer based on percentage influence for suitability of locating the landfill. For weighted overlay analysis, every criterion is assigned with weights according to its relative importance against the other. Attributes of each criterion are also provided with weights relative to each other.

Figure 2 Methodology used in the study



3.3.2 Proximity analysis

One of the major requirements in selecting the landfill site location is its proximity and connectivity to the road network. Other important requirements in site selection are its safe distance from existing drainage, canals, and lineaments. The presence of any of these three features may result in contamination of ground and surface water. Delhi is a city of historical importance having several heritage monuments. Distancing from these heritage monuments is also an important criterion, from the point of conservation of the monuments, providing a hygienic environment for tourists, and as well as from the point of aesthetic value. The spatial buffering technique is very useful in incorporating exclusion zones for important features listed above. Buffer tool creates a polygon around input features to a user-specified distance. Conditional operators are used in the spatial environment to identify the area inside the buffer and outside the buffer. Zones inside the buffer are excluded and not considered for landfill site selection.

MCDA with GIS-based spatial operations is performed on input layers for classifying the study area into most suitable, moderately suitable, and least suitable areas for landfill site selection. Results obtained using the above-mentioned procedures are presented in the result section.

4 Results

4.1 Weighted overlay

4.1.1 LULC data analysis

Land use and the cover are classified into 12 categories, viz., agricultural land, airport, fallow land, forest (jungle) vegetation, forest plantation, habitation, water bodies, parks, wasteland with scrub, wasteland without scrub, waste land-rocky, and permanent fallow land (Figure 3). Landfill sites cannot be selected on agricultural land, forest area, near settlements, and water bodies. Wastelands are the best zones for selecting the landfill site, followed by permanent fallow land as the second priority (Sreenivasan et al., 2020). Different classes of land use derived from Sentinel-2 data are provided with weights based on literature (Karimi et al., 2019; Akintorinwa and Okoro, 2019; Karakuş et al., 2020) and local expert's knowledge in the field (Table 1).

The highest weight is assigned to wasteland rocky, a wasteland with or without scrub, and permanent fallow land. Other classes are given the least weightage in landfill site selection as these are not the preferred land use for locating a landfill.

Figure 3 LULC map of Delhi NCT (see online version for colours)

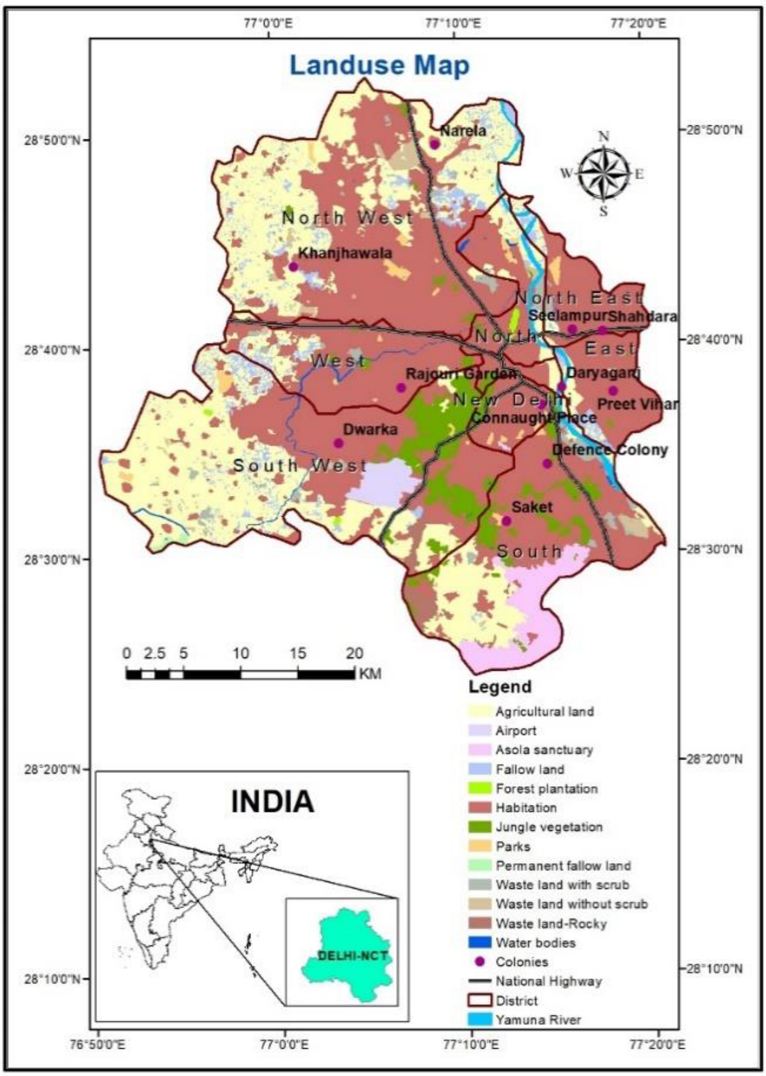


Table 1 Assigned weights for LULC

	LULC class	*Weights*
1	Agricultural land	0
2	Airports	0
3	Fallow land	1
4	Jungle vegetation	0
5	Forest plantation	0
6	Habitation	0
7	Water bodies	0
8	Parks	0
9	Waste land with scrub	8
10	Waste land without scrub	8
11	Waste land-rocky	9

4.1.2 Groundwater table data analysis

Map of groundwater table map (Figure 4) was taken from CGWB (2019). Appropriate weights have been assigned to the groundwater table (Table 2). For reducing groundwater contamination, areas with a water table less than 2 m below ground level (bgl) are least suitable for the development of landfills, hence assigned a weight of 1, however, a groundwater table of 20–40 m bgl is best preferred, as it minimises the chance of mixing leachate with the groundwater.

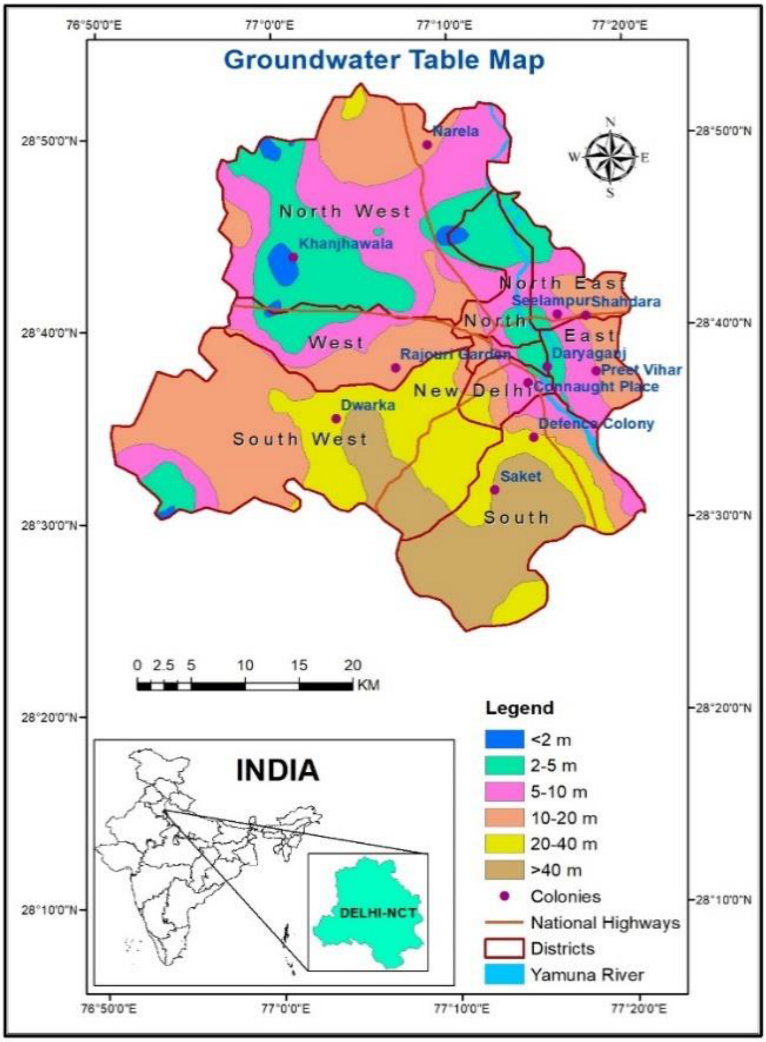
Table 2 Assigned weights for groundwater table

S. no.	*Groundwater table (bgl)*	*Weights*
1	<2 m	1
2	2–5 m	3
3	5–10 m	5
4	10–20 m	7
5	20–40 m	8
6	>40 m	9

Table 3 Assigned weights for geomorphology criteria

S. no.	*Landforms*	*Weights*
1	Active flood plain	1
2	Pediment	8
3	Older alluvial plain (Bhangar)	2
4	Older flood plain	2
5	Plateau	8
6	Ridge	0

Figure 4 Groundwater table map of Delhi NCT (see online version for colours)

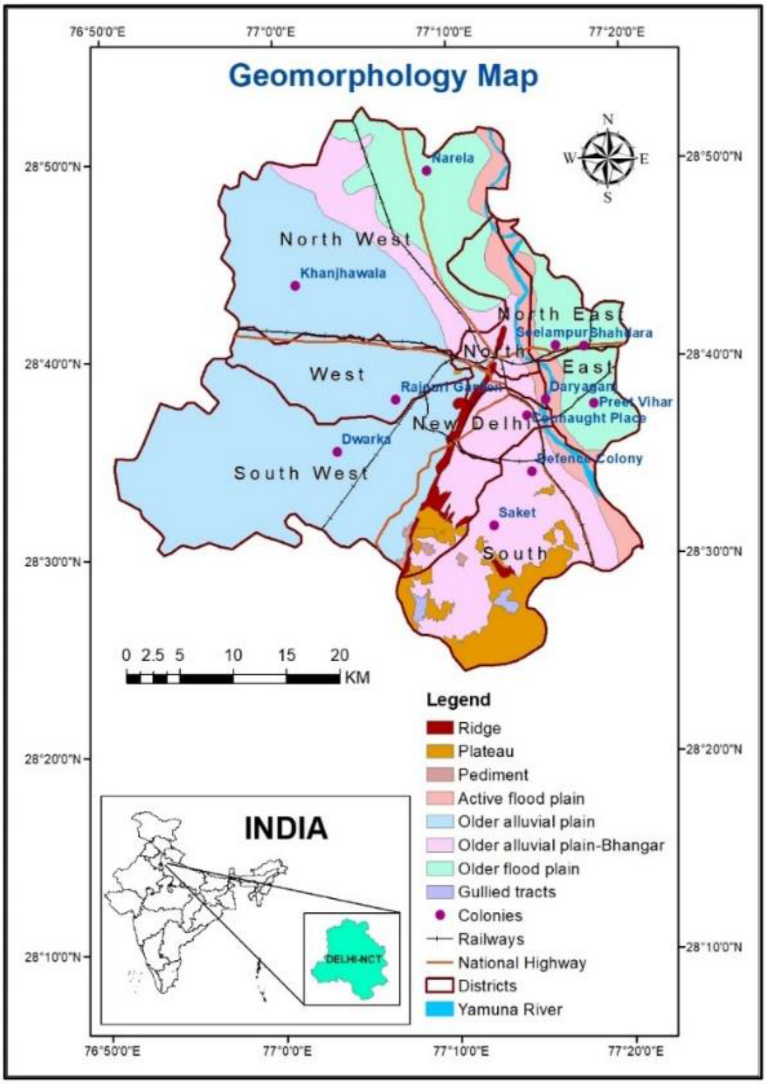


Source: CGWB (2019)

4.1.3 Geomorphology data analysis

Geomorphology, which studies the landforms of an area, is an important factor in landfill site selection. Landforms convey the nature of the terrain-topographical conditions of an area, which have an impact on the location and functioning of a landfill, and therefore are an important consideration for identifying suitable sites for landfills. Delhi NCT area has mainly active flood plains, pediments, alluvial plains, plateaus, and ridges (Figure 5). Active flood plains are avoided for locating landfills and given the least preference, whereas ridge areas are assigned as 0 weightage, as these landforms are absolutely unsuitable for locating landfills. Weights are assigned to different landforms based on the prevalent criteria available for the suitability of the different landforms for locating the landfills (Chatterjee et al., 2009) and presented in Table 3.

Figure 5 Geomorphology map of Delhi NCT (see online version for colours)

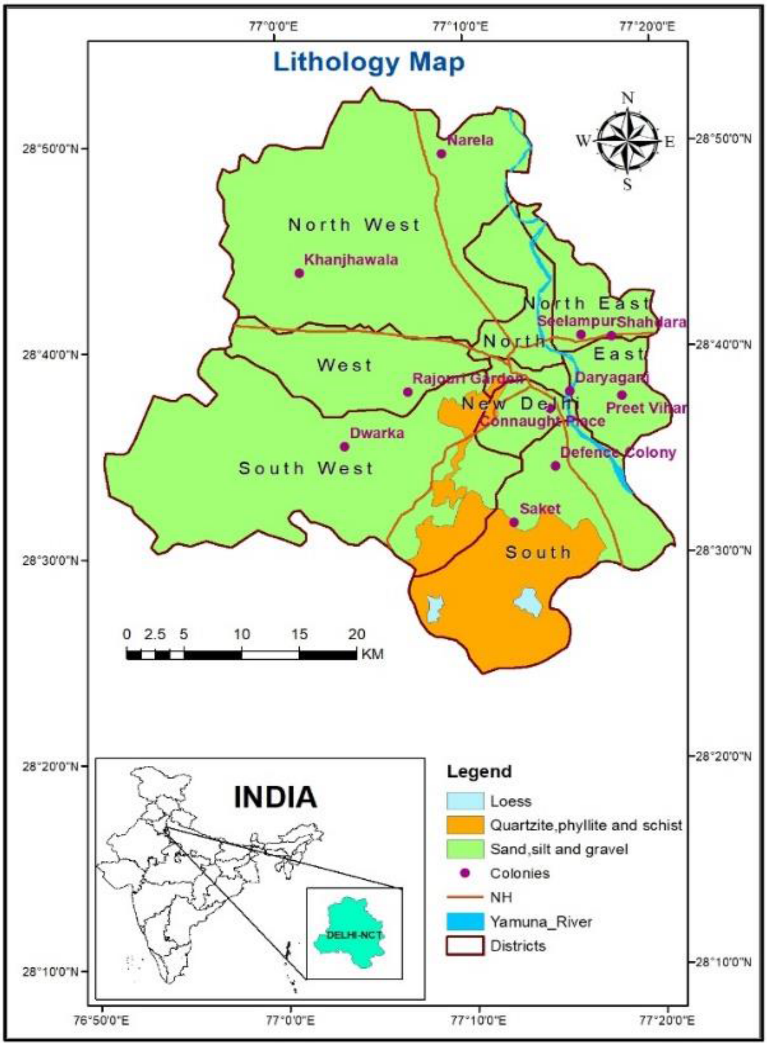


Source: Modified after Chatterjee et al. (2009)

4.1.4 Lithological data analysis

A large part of the Delhi NCT area is mainly constituted of Indo-Gangetic Plains covered by quaternary alluvium made up of sand, silt, and gravel. Some part in the south is covered by quartzites, phyllites, and schists belonging to the Delhi Supergroup (Figure 6). For landfill site selection analysis, areas having sand, silt, and gravel are least preferred as these have high percolation and may lead to contamination of soils and groundwater. Areas having quartzite, phyllite and schist are preferred in the study area, as these are hard rocks with low percolation. Weights assigned for different lithological units are given in Table 4.

Figure 6 Lithology map of Delhi NCT (see online version for colours)

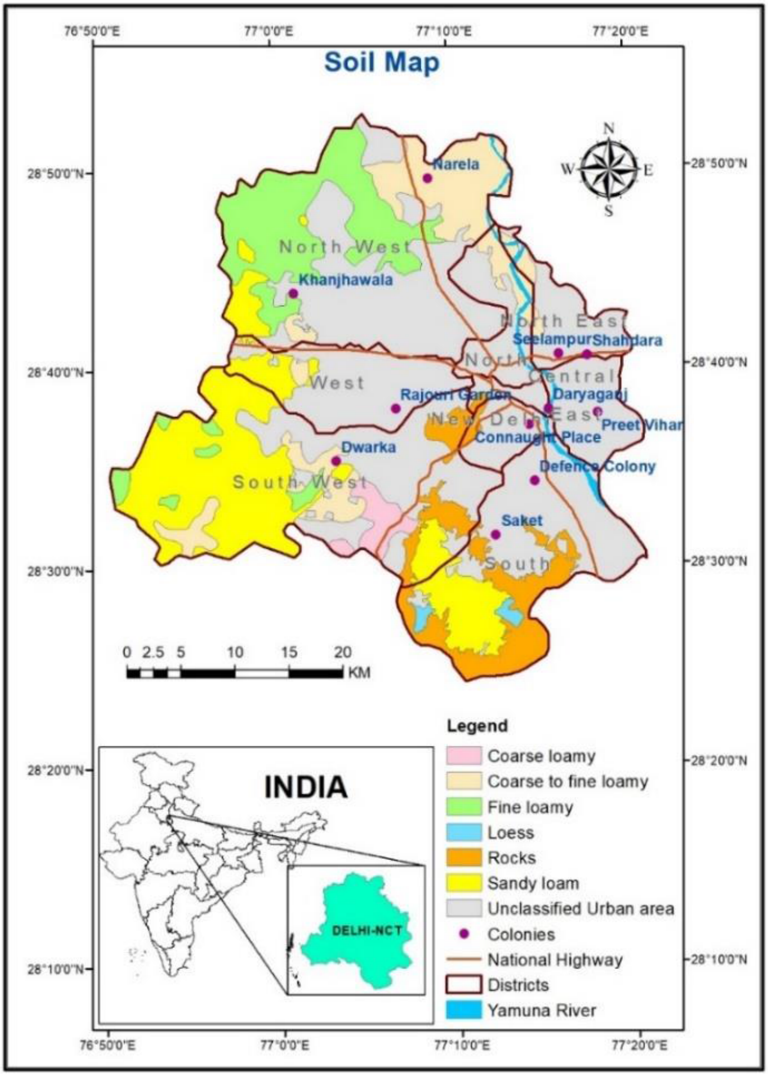


Source: NRSC (2015)

Table 4 Assigned weights for lithological criteria

S. no.	*Lithological units*	*Weights*
1	Loess	5
2	Quartzite, phyllite and schist	9
3	Sand, silt and gravel	1

Figure 7 Soil Texture map of Delhi NCT (see online version for colours)



Source: National Bureau of Soil Survey and Land Use Planning (1979)

4.1.5 Soil data analysis

Soil is one of the most important parameters considering landfill site suitability analysis. Soil texture mainly plays an important role in the identification of suitable sites for landfills. Delhi NCT area is mainly covered by sandy loam, fine loam, and coarse to fine loam type of soils (Figure 7). Small areas are covered by coarse loamy soils. Some areas have almost no soil cover or have a very thin layer of soil with shallow sub-surface rock. For locating the landfills, sandy loam soil type is given the least preferred because of its high percolating property. Leachate percolation from the landfills to the soil needs to be avoided. Therefore, areas with the least soil cover or barren rocky areas, which have the least percolation, have been given the highest weightage in soil data analysis. Other areas with loess type of soil and fine loamy soils have been given the next priority for locating the landfills. Weights assigned for the different soils of Delhi NCT are given in Table 5.

Figure 8 Percentage slope map of Delhi NCT (see online version for colours)

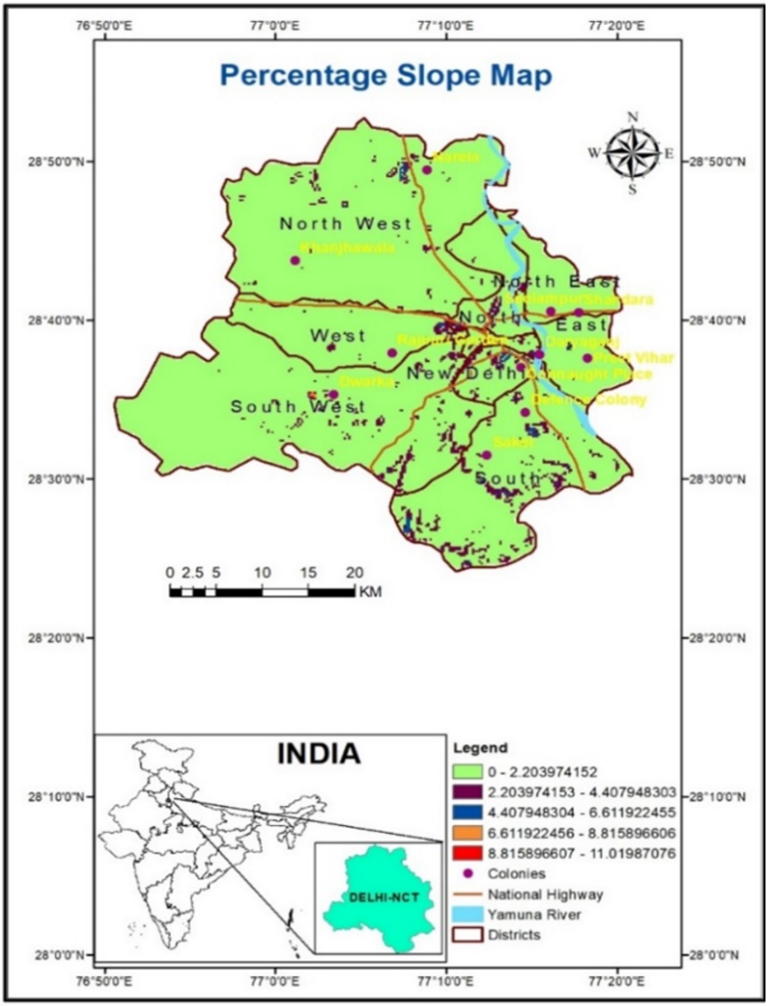


Table 5 Assigned weights for soil texture types

S. no.	*Soil texture*	*Weights*
1	Coarse loamy	4
2	Coarse to fine loamy	5
3	Fine loamy	6
4	Rocks	9
5	Sandy loam	1
6	Loess	7

4.1.6 Slope data analysis

The slope of the study area (Figure 8) is derived from the digital elevation model of GMTED data (https://www.usgs.gov/core-science-systems/eros/coastal-changes-and-impacts/gmted2010). In this study, areas with a higher slope percentage are avoided while the areas with a lower slope percentage are considered suitable for landfill construction. A slope in the range of 8–11% is considered to be the least suitable, and a slope in the range of 0–2% is considered to be the most suitable location for landfills. A slope in the range of 2–4% is considered as moderately suitable (Al-Hanbali et al., 2011; Poorna and Vinod, 2016). The area with the least percentage slope is considered best for landfill construction because construction of a landfill requires pit construction and a rather simpler plane area so that solid waste disposal would not be delinquent for the population nearby. Detailed criteria based on the slope are shown in Table 6.

Table 6 Assigned weights for percentage slope

S. no.	*Slope (percentage)*	*Weights*
1	0–2%	9
2	2–4%	7
3	4–6%	5
4	6–8%	3

4.1.7 Weighted overlay analysis

Theme maps based on six different themes namely, LULC, groundwater table, geomorphology, soil texture, lithology, and slope are further analysed using weighted overlay analysis. Individual weights, assigned to each parameter based on available guidelines from various sources (Al-Hanbali et al., 2011; Poorna and Vinod, 2016) are shown in Table 7.

Table 7 Themes weight for weighted overlay analysis

S. no.	*Criteria*	*Weights (%)*
1	Land use land cover	25
2	Geomorphology	15
3	Groundwater table	15
4	Lithology	10
5	Soil texture	20
6	Slope	15

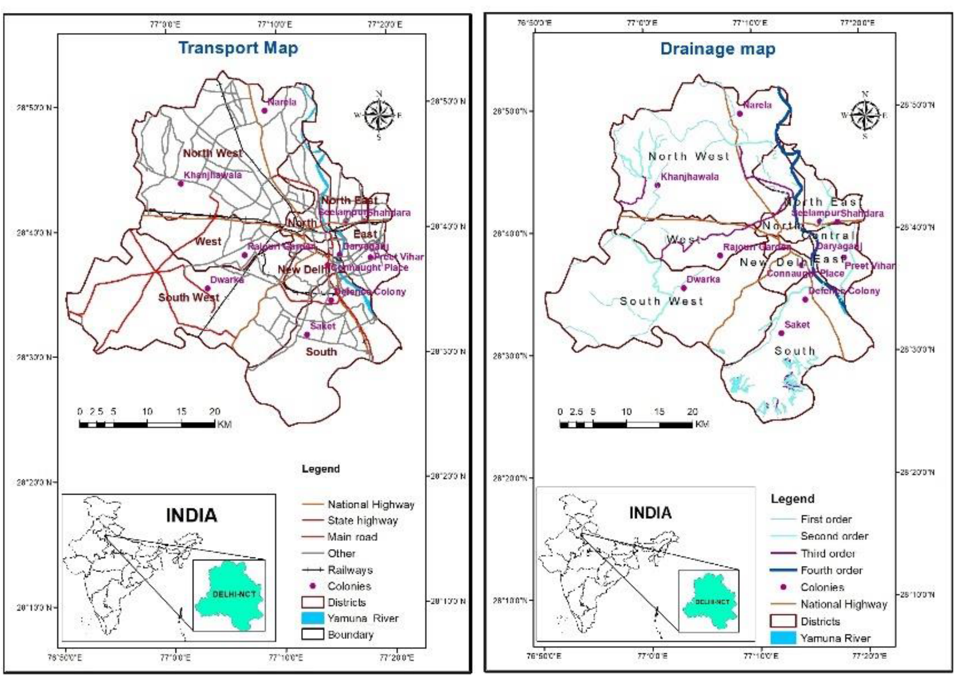
4.2 Proximity analysis

Landfills should be constructed away from national highways, state highways, other major roads, and railways [Figures 9(a)–9(e)]. Also, landfills need to be placed at a safer distance from drainage, canals, important monuments, fault lines, and lineaments. Identification of suitable locations fulfilling the above criteria can be achieved using spatial buffering. Distance buffer is taken for site suitability analysis. Regions coming under the specified buffer distance from the features, as shown in Table 8, are excluded and not considered as a landfill sites. Distance considered for buffer generation is based on guidelines issued by various government bodies (Sisay et al., 2020).

Table 8 Themes weight for weighted overlay analysis

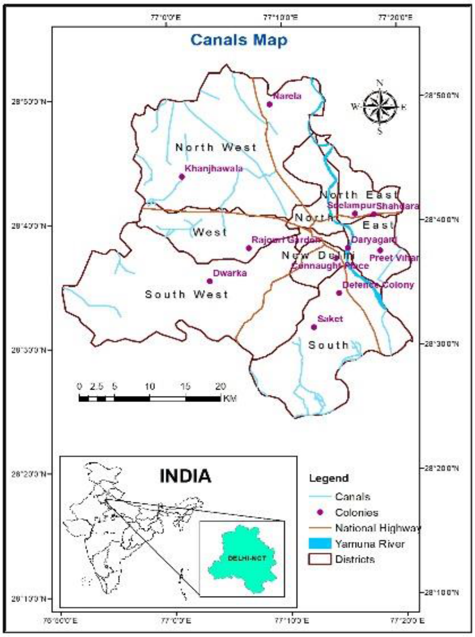
S. no.	*Criteria*	*Sub-criteria*	*Buffer distance*
1	Transport	National highway	500 m
		State highways	500 m
		Major roads	300 m
		Other roads	250 m
		Railways	500 m
2	Drainage	First order	100 m
		Second order	200 m
		Third order	400 m
		Fourth order	500 m
3	Canals		300 m
4	Lineaments	Major	100 m
		Minor	61 m
5	Monuments		2 km

Figure 9 (a) Transport map of Delhi NCT (b) Drainage map of Delhi NCT (c) Canal map of Delhi NCT (d) Lineament map of Delhi NCT (e) Monument map of Delhi NCT (see online version for colours)

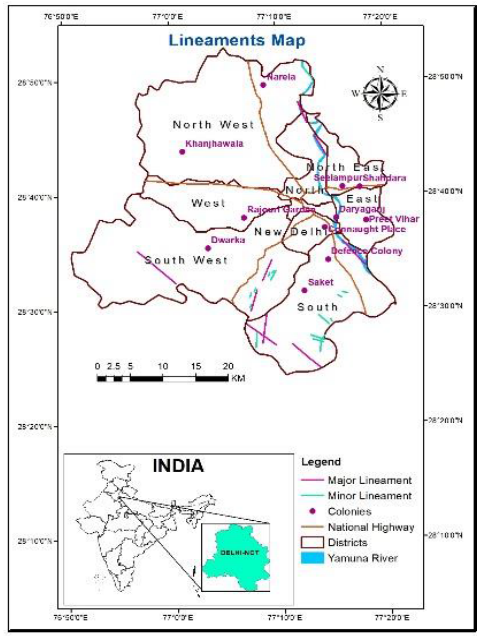


(a) (b)

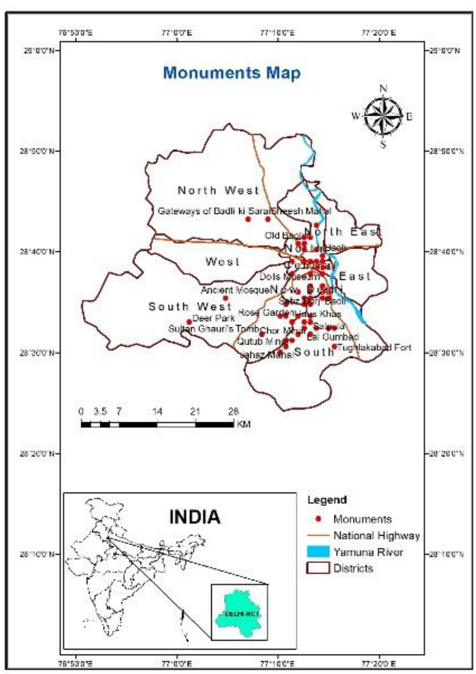
Figure 9 (a) Transport map of Delhi NCT (b) Drainage map of Delhi NCT (c) Canal map of Delhi NCT (d) Lineament map of Delhi NCT (e) Monument map of Delhi NCT (continued) (see online version for colours)



(c)



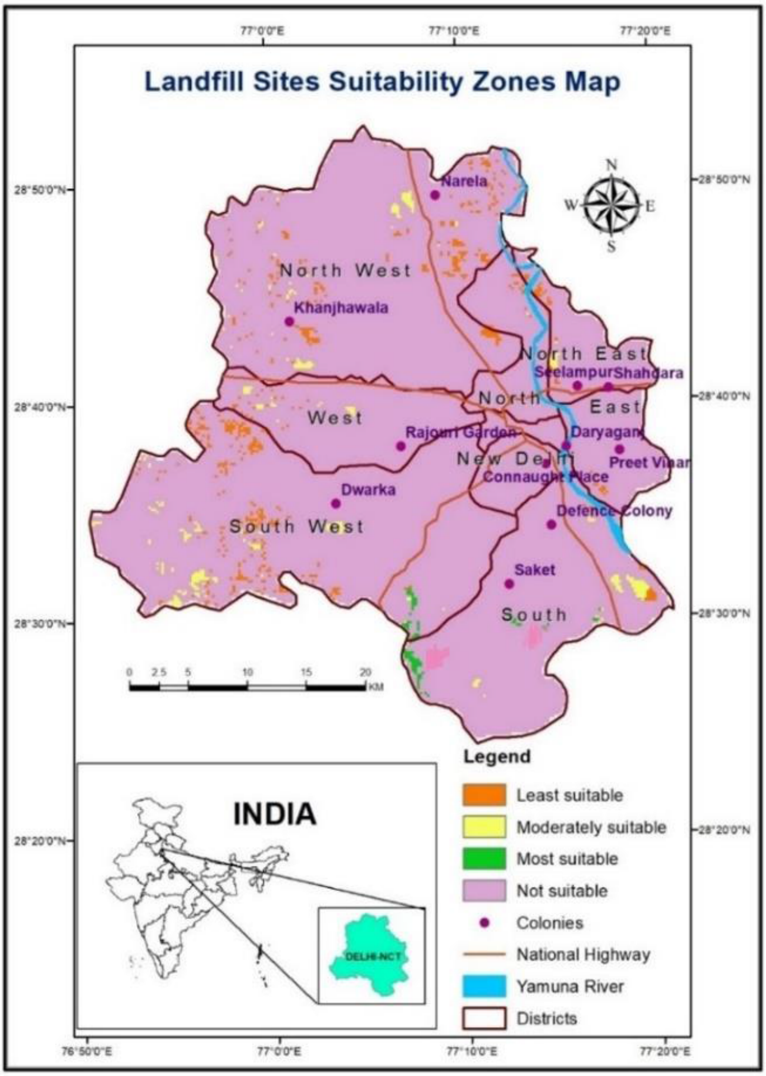
(d)



(e)

After performing buffer analysis and identifying the relative importance of each criterion in the site selection process the final step is to obtain the suitability of each location. Integration of results obtained using weighted overlay and buffer analysis provides a final landfill suitability map categorising the study area into not suitable, least suitable, moderately suitable, and most suitable regions as shown in Figure 10.

Figure 10 Final suitability map for construction of landfill sites in Delhi NCT (see online version for colours)



5 Discussion

The study has used the remote sensing techniques and GIS capabilities integrated with MCDA for identifying suitable sites for constructing landfills in the study area. Open-source libraries like GDAL are successfully utilised in handling multi-source heterogeneous datasets by transforming input datasets in uniform projection and format. Further, the libraries are successfully utilised in analysing the spatial datasets, showcasing the capabilities of open-source tools in areas of site selection.

Categorisation of results in terms of not suitable, least suitable, moderately suitable, and most suitable facilitates local authority to utilise the available vacant sites for other purposes like car parking, development of open spaces as parks, etc. The results of the analysis show that the maximum part of the study area, i.e., 95.62% is not suitable for setting up landfills. Most of Delhi is urbanised. Landfills cannot be constructed on or near population settlements as it will cause numerous problems to the habitants like filthy odour, decrease in aesthetic value, exposure to hazardous fumes and pathogens, mosquito breeding, etc. Not suitable places also include agricultural lands. Constructing landfills on or near agricultural land would result in crop damage due to soil and groundwater pollution. Areas with important infrastructure like airports, parks, heritage monuments, transport networks, drainages, and water bodies and their vicinity zones are also not suitable for landfill selection and are successfully excluded using GIS operations. Areas near geological fault lines and lineament zones are also excluded from consideration for constructing landfills, as these areas may allow seepage of leachates generated from the waste to the sub-surface and thus lead to pollution of soils and groundwater.

The most suitable areas for landfill construction are situated in the southern part of Delhi. Most suitable areas for landfill construction are shown in green colour. The suitable area confined to the southern part of Delhi is favourable with respect to its geological, geomorphological, topographical, and environmental suitability. In Figure 10 only those areas are highlighted in green colour which is large enough to construct a landfill. They identified suitable areas are covered by rocks made up of quartzite, phyllite, and schist, and have very little or no soil cover. These areas are away from geological weak zones like faults and lineaments. Geomorphologically, these areas are covered by pediments and the slope rise of the area is between 0–2%. These areas are environmentally suitable, as they are away from fertile agricultural lands and water bodies. In these areas, the groundwater table level is greater than 40 m making it a more suitable area for landfills. It is at a safe distance from the rivers, drainages, canals, and historical monuments. The area is also at a safe distance from major roads, but not too far from other roads, as the roads are necessary to transport waste from other parts of the city to the dumping site. The present work successfully identified the suitable and non-suitable areas for constructing the landfill sites using GIS integrated MCDA.

6 Conclusions

New sites for the construction of landfills in the NCT of Delhi are proposed in this study by utilising remote sensing data, and a GIS-based multi-criteria decision analysis technique. Six criteria were taken for weighted overlay analysis and five criteria for proximity analysis. Open-source libraries like GDAL have been utilised successfully to process the input data which is further analysed using the MCDA technique for landfill site selection.

The study has shown that 0.27% area of Delhi is most suitable for the construction of landfills while 0.98% is moderately suitable, 1.71% is least suitable and a majority of the area 95.62% is not suitable for landfill construction. Scientific analysis and categorisation of the study area into different suitability classes can be useful to the policy makers for planning the development of new landfills in Delhi NCT by enforcing all environmental guidelines, thus helping in the sustainable urbanisation of the Delhi NCT. The geospatial data, along with the final suitable zones map, can form important inputs for preparing DPR for landfill construction. Besides, the methodology can be applied to other mega-cities having similar solid waste management problems.

Social factors like land pricing, land ownership, etc. are not considered in this study. However, we recommend that, for practical implementation of these results by the Government, integration of social information along with the scientific feasibility results of this study may be considered.

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