

Chapter: 3

Study Area

3.1 General

To accomplish the objective of the work, Ramna and Karsara village area selected. Ramna village area is mainly focus due to its high population and situated very near to the MSW dumping site. Both the study areas are located in the Varanasi city which is in the eastern part of the state of Uttar Pradesh in the middle Ganga valley of North India. The Varanasi urban agglomeration has an area of 112.26 km² being located in the Gangetic plains of north India. Varanasi has a humid subtropical climate with high variation between summer and winter temperatures. The average temperature is 32°C-46°C in summer and 5°C – 15 °C in winter. The city receives rainfall during south-west monsoon. The average annual rainfall is 1,110 mm. The demand of water is increasing due to population increase and urbanization factors in city which leads to excessive pumping of groundwater. On an average, 661 metric tons of solid waste in a day is produced in the Varanasi city, but only 87% of which is collected for final disposal and the rest is left unturned. This is primarily due to the lack of effective waste collection, transportation and disposal practices [95]. Even after the MoEF (ministry of environment and forest) notification on MSW (Management & Handling) rules, 2000 [13] the urban local bodies have failed to comply with the same. This situation is not only affecting the environment but also causing groundwater pollution. In Varanasi city municipal solid waste mainly comprises commercial waste, domestic food waste, official waste, road sweeping waste, local scale industrial waste, cleanliness waste, and building and destruction waste [96]. Waste composition depends on a wide range of factors such as food habits, cultural traditions, climate and income [97]. Selected MSW dumping sites i.e. Ramna and Karsara are located in between N 25°14'38.3" latitudes and E 83°00'15" longitudes of rural areas of Varanasi city. The selected dumping sites are a non-engineered and low-lying open dumping site. The open MSW landfill sites have been

getting thousands of tons of solid wastes without proper segregation and pre-treatment. Municipal solid waste collected from different localities of the city and brought to this site and dumped in a rough manner. Also, the city is producing huge amounts of municipal solid waste, and due to the lack of scientific, engineered landfills, it's being directly disposed of in low-lying village areas[98]. **The solid waste and soil cover are irregular at the site and there is no any recycle and recover method is used prior to deposit the solid waste in the landfill sites.** The bottom of the dumping is not lined and there is no establishment for the collection of leachate. The open wells and bore wells are the main source of water supply for drinking and other purposes around the study area. The study area is threatened by groundwater extinction, shrinkage of surface water and its contamination, and enormous land pressure. The study area has a tropical climate with mild winter and long summer days.

3.2 Geology of study area

Geologically, the study area is covered by alluvial sediments of the Pleistocene period to recent times which is most vulnerable for leaching[99]. The sandy horizons denote the fluvial activity while thick clay horizons signify the low-energy fluvial phase. The sandy study area located near to the drainage courses of the river Ganga, and the area is prone to flood which deposits a carpet of fresh silt, clay, and loam. So that chemical alteration of solid waste highly takes place and have a chance to leach to subsurface water. The study area and its environs are located at an average height of about 76 m above the mean sea level and have largely even topography[100]. Geochemically the groundwater mostly (81%) belongs to the calcium bicarbonate type. The meander belt sand deposits form the main groundwater body in the area and supply water to a large number of tube wells used for irrigation, industrial and domestic purposes. The deep groundwater body considered to be hydraulically continuous is

known to be confined locally. The piezometric surface of the deep body varies and is generally known to be deeper in comparison to the static water level of the shallow water body. The groundwater table in the study area has gone down to 4.6 m (15 feet) below the level it used to be earlier. The most important source to sustain groundwater body in fine to coarse-grained sands of the older alluvium is rainfall that seeps down to the water table. Other sources include infiltration from river Ganga. There is no established system of groundwater recharging in the city. Although the crisis of water is prevalent in the whole city, the southern part is suffering more owing to lowering of groundwater each year. Groundwater in the study area is occurring in two distinct sedimentary horizons namely that is back swamp clays containing kankar having an average thickness of about 50 meters and the underlying meander-belt deposits consisting of fine to coarse-grained sands having an average thickness of about 60 meters [95]. Clay and silt type characteristic of the soil generally hinder the precipitation, complication the and so the absorption of heavy metal leached from MSW [54].

3.3 About MSW dumping sites

Ramna and Karsara dumping sites were selected for the present study. Ramna MSW landfill area was located between $25^{\circ}14'38.3''$ N latitudes to $83^{\circ}00'15''$ E longitudes while Karsara dumping site located between $25^{\circ}12'50.88''$ N latitudes to $82^{\circ}55'6.75''$ E longitudes in Varanasi city, state of Uttar Pradesh, India. Ramna dumping site is recently coming in function from 2012 and spread over an area of approximately 53 acres while Karsara dumping site is spread over approximately 18 acres. Karsara dumping site is very closed to river Ganga and surrounded by agricultural fields and settlement area.

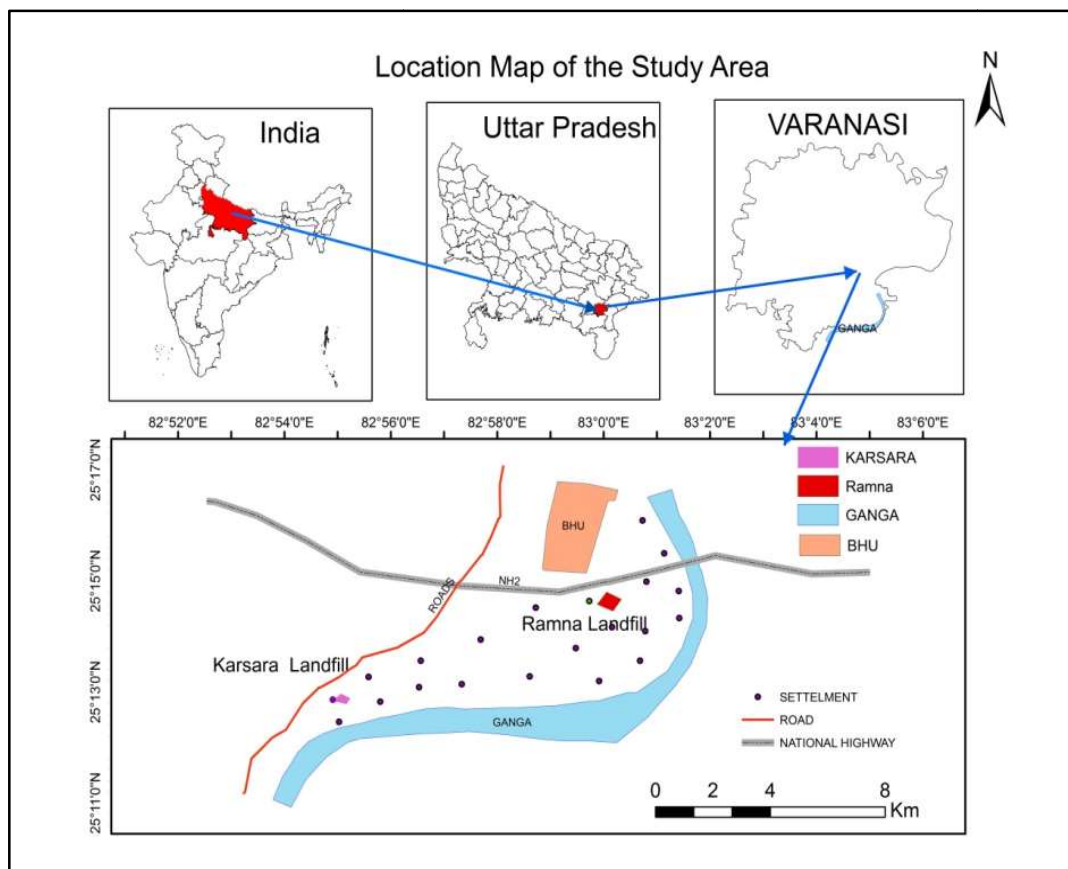


Figure 3.1 Map of the study area.

Ramna dumping site situated along the National Highway (NH-2) from the north side and another side it is covered by agriculture fields and village area. From both the sites, there is a great possibility of groundwater pollution due to leachate percolation during the rainy season.

3.4 Ramna study area.

The RamnaMSW dumping area is located at approximately 2.64 kilometres in the west of the river Ganga and is surrounded by agricultural fields and residential area. This dumping site witnessed the fire the outburst in November 2014 affecting the environment of Ramna and other neighboring villages. The villagers had frequently complained against dumping of waste in the site and demanded for its immediate closure. Yet there is no proper action taken by municipal and district authorities to

mitigate its impact on surrounding environment especially air and water quality. The dumping site at Ramna is a temporary arrangement after solid waste management plant at Karsara was closed due to a dispute between the Varanasi Municipal Corporation and the company engaged for waste collection and disposal. Municipal Solid Wastes (Management and Handling) Rules, 2000 [13] states that the landfill site should be away from residence clusters, but opposing to the rule the dumping sites are surrounded by several villages including Ramna, Dafi, and Seer. According to the rule, wastes subjected to landfilling should be compacted in thin layers using landfill compactors to attain a high density of the wastes and it should be covered immediately or construction material until waste processing facilities for composting. But, no such provisions have been made here(Times of India, 2016).



Figure 3.2 Municipal solid waste dumping sites in Ramna village.



Figure3.3 Ramna MSW Leachate.



Figure 3.4 Karsara MSW leachate.

3.5 Karsara study area.

The Karsaradumping site was selected for present study, located between 25° 12' 50.88" N latitude to 82° 55' 6.75" E longitude in Varanasi City, Uttar Pradesh, India. It is non-engineered without having any base liner leachate collection system, situated in the low-lying dump area and covering a 6 km² area, which is 80.7 m above mean sea level. Karsara dumping site has been inactive between 2012 to 2017 year. The dumping site is located at approximately 738 m north of the river Ganga (Figure 3.1) and mostly surrounded by agricultural fields and settlements. The climate of the study area is humid subtropical with high and severe cold (8.4 to 15.0 °C) during the winter seasons temperatures (38.5 to 41.2 °C) during the winter seasons.

Thus from the both the study sites, there is a great possibility of groundwater pollution due to leachate percolation during the rainy season. So these site selected for the research study.

