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Monitoring Expanse Near Lakhodair Landfill and Mehmood Booti Dump Sites of Lahore, Paksitan

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Abstract: Solid waste management in any large urban city like Lahore requires special disposal measures. In this regard, Lakhodair landfill and Mehmood booti dump sites collect and handle major bulk of all the solid waste coming from ten towns of Lahore, with the city's waste generation rate of being 0.84kg/capita per day. Spatial expanse of both the sites was calculated in Arc GIS 10.3 system. The findings clearly showed that the extent of both these dump sites had increased during 2006-2016 due to an enormous rise in solid waste generation. During 2006, the area of Mehmood Booti dump site and Lakhodair Landfill site was only 15 hectares and 17 hectares respectively. By 2016, this area had increased to 32 hectares and 52 hectares respectively. The mapping of these two sites can help in future researches based on investigating the disease patterns among people residing around these sites and by determining methane emissions in the study area.

Keywords: Remote sensing, GIS, solid waste, landfill, open dump sites, Lahore.

Introduction

Municipal solid waste management has been a neglected area in urban centers across the globe. With rapid urbanization in the world, the volume of civil solid waste, major side-effects of urban lifestyle are increasing significantly quicker than the level of urbanization. The worldwide contribution of Municipal Solid Waste (MSW) is about 1.3 billion tons/year i.e. 1.2 kg/capita/day. Ten years ago, waste built up rate was about 0.64 kg/capita/day i.e. 0.68 billion tons/year. World Bank (2012) speculates that the global solid waste generation will reach 1.42 kg/capita/day i.e. 2.2 billion tons/year, as generated by the 4.3 billion urban inhabitants by the year 2025 (Hannan et al., 2015). Throughout the world, specifically in urban areas, municipal solid waste management is being neglected (Ahmed and Ali, 2004; Al-Khatib et al., 2010; Batool and Ch., 2009; Chung and Lo, 2008; Imam et al., 2008; Metin, et al., 2003; Zhen-Shan et al., 2009). One of the most economic forms of solid waste disposal is in landfills in majority of the cases, which is an environment friendly method of waste disposal as opposed to open dumping (Khalil et al., 2018; Carra and Cossu, 1990; Rushbrook, 1984; Thompson and Zandi, 1975),. About 95% of the world's solid waste is being deposited in the landfills (Bingemer and Crutzen, 1987; Carra and Cossu, 1990; Cossu, 2012; Gendebien et al., 1992).

Although urban development has greatly encouraged the employment opportunities, better life style and social services, but this has also led to unsustainable utilization of different natural resources resulting in causes problems like municipal solid waste management (Lwasa et al., 2007). Lahore, the provincial capital, produces 5,700 tons of solid waste from different sources with high percentage of organic waste, i.e.70%, daily, with a generation rate of 0.84kg/capita per day (Batool and Ch., 2009). The current study is of great significance as it is a multi-dimensional issue. Solid waste management has been neglected in Lahore due to poor infrastructure (Moghadam et al., 2009) improper bin collection and transfer, lack of knowledge about the routes, schedule and collection (Hazra and Goel, 2009). Waste management has formed one of the foundation stones of the Vision 2020, since it is used as a benchmark to measure the advancement of a country towards the Vision 2020 (Ahmad et al., 2014).

Lahore is the capital city of Punjab province that covers an area of about 1772 km^2 (Masood et al., 2014). It is situated within the geographic extent of 31° 13' and 31°43' N latitude and 74° 0' and 74° 39.5' E longitude (Ghaffar, 2015). Lahore was selected as a study area because in 2009, the towns of Lahore city delivered around 5000 tons/day of civil solid waste, where 60% of the waste was gathered and discarded in the open dump sites (Batool and Ch, 2009) and later major investments were made to restructure its Solid Waste Management (SWM) system (Masood et al., 2014). Lahore Waste Management Company (LWMC) is currently responsible for solid waste management (SWM) that has been in operation since 2011 (Masood et al., 2014). In 2012, LWMC signed a contract with two Turkish companies namely, Albayrak and OzPak for the waste collection and transportation to the disposal sites (Masood et al., 2014). All the generated solid waste in the low-to medium-income developing countries is transferred to the landfills. Even in some countries from the

developed world, it continues to be the most popular method of waste disposal (Aljaradin and Persson, 2012). About 6 million tons of solid trash has been dumped from 1996 to 2010 at Mahmood Booti and after that a new site Lakhodair was selected for dumping (Mehmood, 2014).

The objective of this study was to examine, compare and map the physical expanse of Lakhodair landfill site and Mehmood booti dumpsite of Lahore with the help of past satellite imagery during 2006-2016. The Mehmood booti dump and Lakhodair landfill sites in Lahore are significantly important to study, since both sites are continuously experiencing an increase in area, due to uncontrolled waste dumping and landfilling. In this context, Lakhodair landfill site is much more planned in contrast to open dumping site of Mehmood booti. This study is significant since gauging the expanse of major landfill and dumpsites of Lahore has remained unexplored. Present study and its maps can prove helpful for the future studies to estimate methane production from those landfills and knowing the disease trend among the population living near those sites. This study shows by temporal mapping and direction in which the landfill dump sites are expanding.

One of the major sites for municipal waste dumping in Lahore is Mahmood booti (Batool and Ch, 2009). Mehmood booti is the largest dump site of Lahore established in 1996 and situated within Muhammad Union council of Wagah town. It is bounded by north of Bund road Lahore and located at 31˚36'39.90" N latitude and 74˚23'08.57" E longitude. Whereas, Lakhodair landfill is situated within Lakhodair village of Wagah town and bounded by ring road Lahore. It lies between 31˚37'36.62" N latitude and 74˚25'07.64" E longitude.

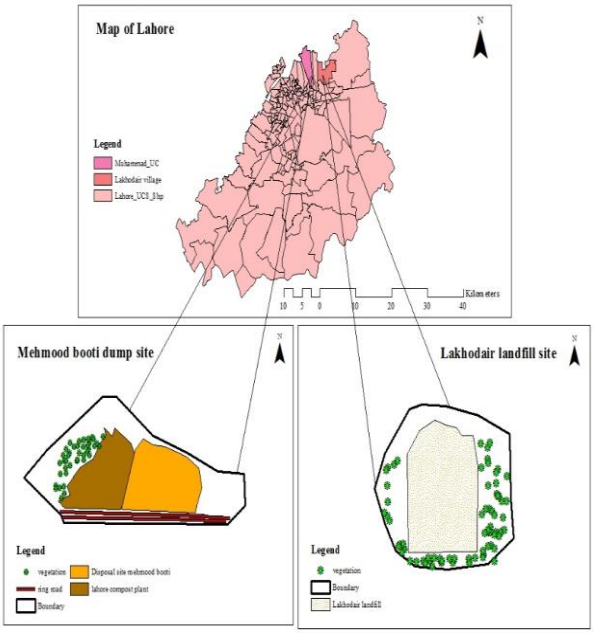

Fig. 1 Location of Lakhodair landfill and Mehmood Booti dump sites.

Materials and Methods

There remains a void in literature regarding the identification, characterization and localization of dumping sites in Lahore. The assessment of the landfill volume was based on the surface area of the landfill by comparing it with the temporal mapping of past 10 years. In the present study, the main waste disposal sites were visited in Lahore for ground survey and then characterized on the basis of the following parameters (Stanisavljević et al., 2012).

- Location.
- Direction of Expansion.
- Quantity of waste Compaction.

Different GIS technologies have been used for solid waste management based on the basis of site selection (Basagaoglu et al., 1997; Kao, 1996; Muttiah et al., 1996; Şener et al., 2011; Sfakianaki and Kasis, 2010). By utilizing the current data acquiring advancement, the acquisition of data sets can be quickened by perceiving and tracking the focused objects quantitatively and effectively. These Information and Communication Technologies (ICTs) are critical for applications, where constant acquisition of data is a necessity (Faccio et al., 2011). The study was carried out during the period from 2006-2016. In order to analyze the expanse of both dump and landfill sites, the data were acquired from historical satellite imagery with the help of Google Earth Explorer by using time slider. Similarly, the data have been analyzed and processed on Arc Geographic Information System (GIS) software in many researches (Basagaoglu et al., 1997; Cossu, 2012; Kao, 1996; Muttiah et al., 1996; Şener et al., 2011; Sfakianaki and Kasis, 2010). Historical images of Mehmood booti dump and Lakhodair landfill sites were digitized, in ArcGIS. When the area was acquired from past satellite imagery in the form of a polygon then the expanse of landfill and dump sites, was calculated by using calculate geometry tool, with the coordinate system of Universal Transverse Mercator (UTM), zone 43˚N. Estimating waste generation of an area is influenced by many factors and the most important of them is temporal factor (Ashraf et al., 2016).

Results and Discussion

Results of Figure 2 showed that during 2006 to 2012, the expanse of Mehmood booti dump site varied from 12ha to 17ha but the total area of Mehmood booti due to existence of Lahore compost plant remained 24ha to 27ha (Fig. 2). However, size of dumping site increased from 15ha to 20ha during 2013-2016 and the total area with Lahore compost plant reached about 29ha to 32ha.

Therefore, findings unveil that Mehmood booti experienced expansion in area with the passage of time due to higher uncontrolled dumping activities. Similar trends have been seen in the Kaohsiung city which is

the largest city in the southern part of Taiwan where the Shichinpu landfill has expanded after 1995 due to the lack of other disposal alternatives in the current solid waste management system and continuously was being used until the year 2003 (Chang and Wang, 1997).

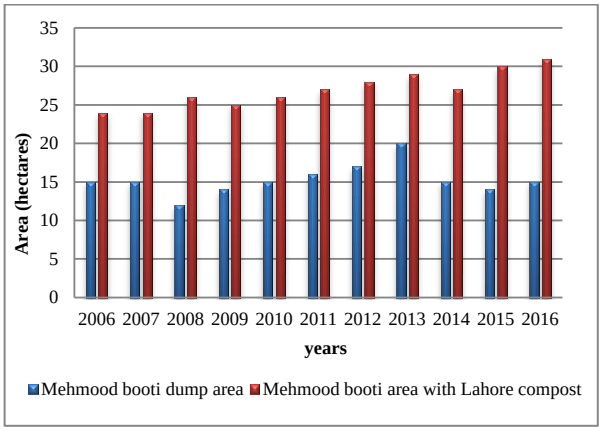

Fig. 2 Expanse of Mehmood booti site during 2006-2016.

During the recent years the amount of waste produced in Lahore has multiplied many times because of consumption patterns of ever increasing urban population (Batool and Ch., 2009). The past satellite imageries showed that Mehmood booti experienced higher expanse with the passage of time during 2006-2010 due to the open disposal of solid waste there. The past satellite imagery in Figures 3, 4 showed that Mehmood booti experienced higher expanse with the passage of time during 2006-2010 due to the open disposal of solid waste (Figs. 2, 3). During 2006-2007, the area of Mehmood booti remained 24 hectares, while in 2008-2009, it had increased to about 26 hectares, which further increased to 28 hectares in 2010 and reached 29 hectares by 2014.

Fig. 3 Satellite imagery: expansion of Mehmood booti site (2006-2010).

However, during 2015-2016, Mehmood booti experienced higher expansion reaching 32 hectares. Similarly in a study of solid waste management (SWM) practices in Lahore, it has been found that Mehmood booti site is over saturated with the waste (Ashraf et al., 2016). Total area of Muhammad Union council of Wagah town (16 km^2) in which Mehmood booti dump site is located. It handles the solid waste coming from nine towns of Lahore and has an area of about 32 hectares in which Lahore compost plant is situated on about 16 hectares, which controls the illegal dumping activities near Mehmood booti dump site.

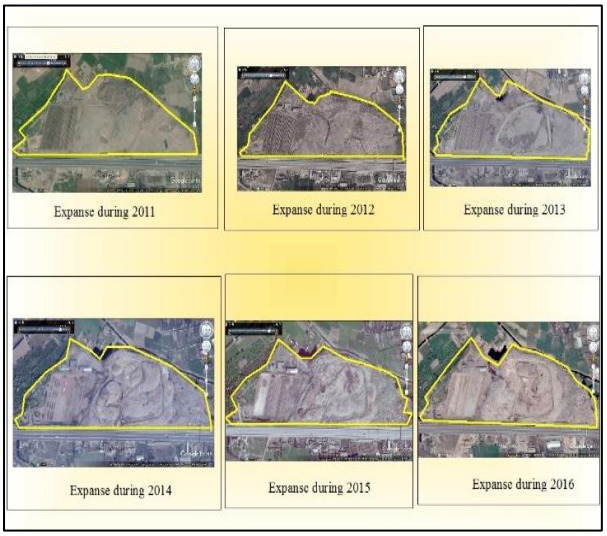

Fig. 4 Satellite imagery; expansion of Mehmood booti site (2011-2016).

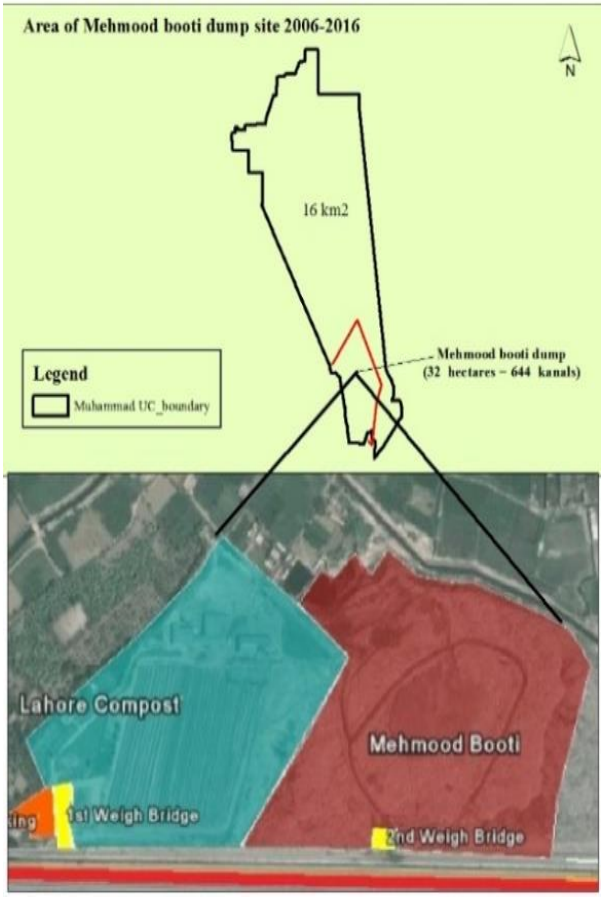

Fig. 5 Total expanse of Mehmood booti site (2006-2016).

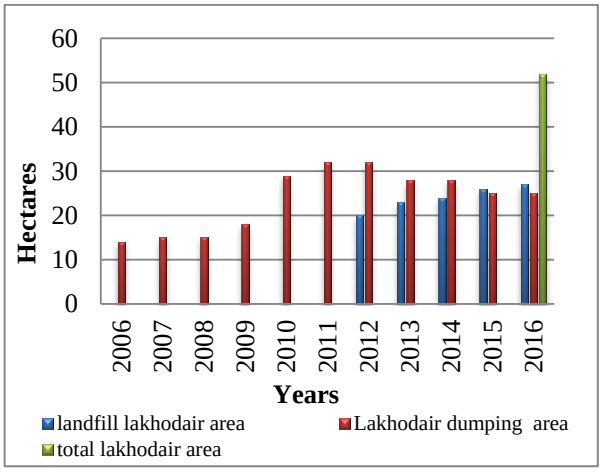

Fig. 6 Expanse of Lakhodair landfill site during 2006-2016.

Lakhodair landfill site is now functioning under LWMC as a dumpsite, since the open dumping Mehmood booti site, had over flown with the waste (Ashraf et al., 2016). The results unveil that the area of Lakhodair increased during 2006-2008 due to the dumping of solid waste, from 14ha to 15ha and increased to 18ha in 2009. The landfill in Lakhodair was constructed in 2012 and the area of Lakhodair reached 52ha during 2015-2016. In between 2011-2014, this dump site area remained 29ha to 32ha. The findings proved that the expanse of Lakhodair landfill site had also increased with the passage of time because of increased solid waste disposal activities.

The past satellite imagery showed that Lakhodair landfill (formed in 2012) also experienced higher expanse with the passage of time during 2006-2016. According to past satellite imagery during the period of 2006-2007, no landfill existed in Lakhodair village (Fig. 7~~, 8~~). It was simply a vegetated area which existed on 14 hectares. During 2008, clear barren land was developed in Lakhodair, and its expanse was 15 hectares. During 2009-2010, it expanded in size from 19ha to 29ha, as the results unveil.

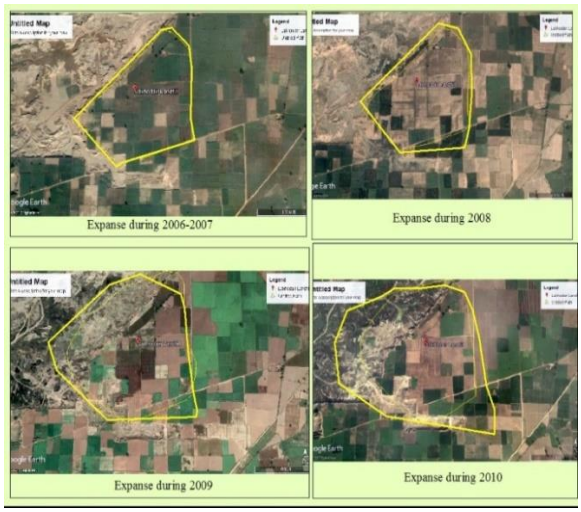

Fig. 7 Satellite imagery; expansion of Lakhodair landfill site (2006-2010).

However, during 2010-2012, (Fig. 8) construction of landfill with the name of Lakhodair started and the area under this site increased to 27ha. Total expansion of Lakhodair landfill by adding area of dump and landfill sites reached about 52ha in 2015-2016.

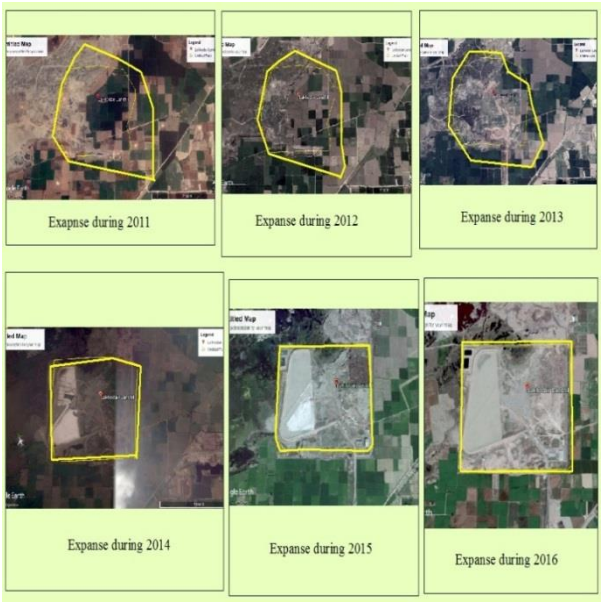

Fig. 8 Satellite imagery; expansion of Lakhodair landfill site (2011-2016).

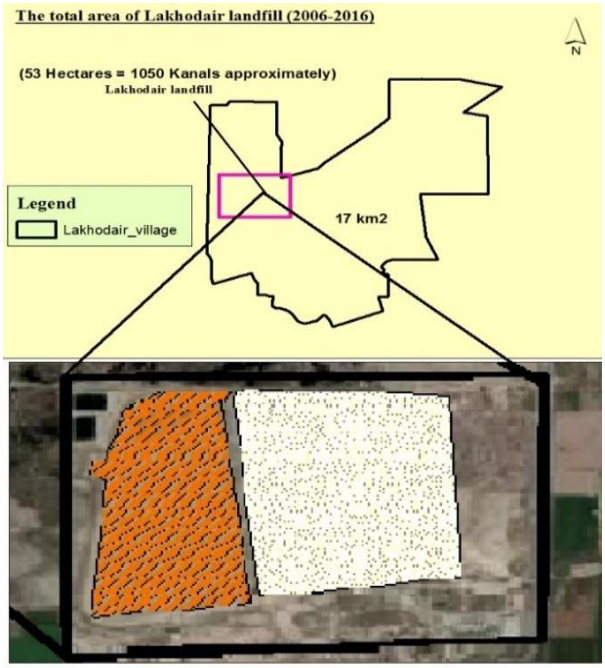

Fig. 9 Map showing total expanse of Lakhodair Landfill.

Similar to our results, is the study carried in out Jordan, which showed an expanse in the area of Mafraq landfill which is known also as the Al-Husaineyat landfill that has a landfilling capacity of 60 years 1986 – 2046(Aljaradin and Persson, 2012). Figure 9 further reveals that the total area of Lakhodair village which is located within Wagah town was 17km^2.The Lakhodair landfill found within Lakhodair

village had a total area for waste disposal of about 53 hectares.

Conclusion

The study concluded that Lakhodair dump site expanded from 14ha to 52ha during 2006 - 2016. Mehmood booti dump site expanded from 15ha in 2006 to 24ha in 2015 but during 2016, Mehmood booti expanded to 32ha due to higher dumping activities dump and the landfill sites under study are not organized enough to handle the waste contribution from the nearby towns. There is a dire need to create a proper waste management system to sufficiently use the resources for general wellbeing of the people. The expansion of landfills can be controlled by increasing the potential to reduce use of energy and generation of pollution in these towns. Future studies can be conducted to estimate methane production from these landfills.

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