Geospatial Alternatives for Mapping Environmental Hazards of Dumped Municipal Solid Waste

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Abstract
This study tries to establish, purify and emphasize the use of freely available satellite data as an easy and cost-effective substitute of expensive and time taking ground measurements for assessment of environmental hazards of openly dumped Municipal Solid Waste (MSW). The study has made use of 55 satellite observations to investigate severity and range of the hazardous influence zone. The average radius for thermal and bio influence zones measured over a span of four years (2016-2019) is 694 m and 760 m respectively, with maximum lies in spring and winter-II (790 m) and minimum in wet summer and dry summer (625 m). Whereas annual clamping in the temperature is as 39-21 °C (2016), 35-16 °C (2017), 34-19 °C (2018) and 36-16 °C (2019). This study concludes that remotely sensed data with the combination of proper spatial analysis is an optimal mechanism for investigating environmental hazards of a pollution source.

Keywords: Environmental variables, municipal solid waste, open dumps, satellite remote sensing, geographic information system.

1. INTRODUCTION
MSW management is a neglected arena of town/city planning across the globe with urban areas throughout the world facing serious issues regarding waste collection and management (Mahmood et al. 2019). Open dumping of waste is the most common waste disposal method in majority of urban localities and is big source of environmental pollution (Duan et al. 2021). The high risks associated with open dumping of MSW make developing countries most vulnerable to ecological degradation (Mahmood et al. 2017). Almost 85% MSW, after collection, is disposed of openly without any essential treatment and processing (Kundariya et al. 2021). Moreover, regarding this critical issue of MSW in developing countries, there is also a lack of relevant scientific literature and operational management systems. The majority of MSW related studies are restricted to the domain of waste characterization and only a few focus on analysis of environmental implications of different waste disposal mechanisms (Mahmood et al. 2019; Kundariya et al. 2021; Mahmood et al. 2022). To

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understand the whole perspective, researchers are increasingly turning towards systemic approach of refined analysis like system dynamics, social network analysis and data envelopment analysis (Mahmood et al. 2022). An effective MSW management system can reduce the health problems and environmental hazards resulting from common waste disposal practices (Singh 2019; Sarfraz and Farhan 2021).

2. METHODOLOGY AND ITS MODIFICATIONS

Development on the methodology since its development in 2016 has been shown in figure 1. With several case studies purification of the method has been made at each step and finally the most improved version of it is shown here as figure 2.

![Figure 1: development and improvement in the assessment strategy](image1)

![Figure 2: Methodology](image2)
Even the given version of the methodology developed for the version is still under the process of improvement with more case studies and more observation. This way the concept of development of coast effective geospatial solutions and purification of the involved spatial analysis is subject to improve with time. Selection of cloud free image is the starting point and an important one as images with cloud cover can result into ambiguous reading. The downloaded has been requested to drive vegetation health and thermal indices. Proximity analysis has resulted into development of vertical profiles.

3. RESULTS

Vertical seasonal profiles for the Mahmood Booti dump have been shown in figure 3 and average results for range and severity towards surrounding region have been shown in figure 4.

Figure 3: Season/year MSAVI graphs
4. CONCLUSIONS

The seasonal average radius for thermal influence zones measured over a span of four years (2016-2019) has been measured to be 748, 750, 626, 662, 631 and 818 m for winter I, spring, dry summer, monsoon, wet summer and winter II respectively resulting in an average range of hazardous zone of 694 m, severity ranges as 39-21 °C (2016), 35-16 °C (2017), 34-19 °C (2018) and 36-16 °C (2019). Whereas the seasonal average values for bio influence zones as measured using MSAVI as the vegetation health index are 798, 768, 700, 802 and 735 m for winter I, spring, dry summer, monsoon, and winter II, respectively resulting an average of 760 m. A valid observation for wet summer due to seasonal absence of any crop. Combining all the Vis and thermal severity range an average impact range of this source of hazardous emissions is 710 m with its maximum lies in spring and winter-II i.e., about 790m, whereas minimum range has been found in wet summer and dry summer i.e., about 625 m. With this demonstration of effectiveness of the proposed methodology this study concludes that remotely sensed data with the combination of GIS analysis is an optimal mechanism for studying, investigating, and quantifying environmental hazards of a pollution source.

REFERENCES