

# Municipal Solid Waste and its Implication in the 2022 Cholera Epidemic in Kathmandu

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## Abstract

*During the monsoon of 2022, Kathmandu valley witnessed an unprecedented number of cholera cases in a brief period- on an epidemic scale. This event corresponded with a month-long stagnation of Municipal Solid Waste (MSW) in the streets of the valley after protests and blockades from the residents in Sisdole- the location of the only landfill serving the valley. This paper has entertained the correlation between the two entities and has scrutinized the idea. To add to the study, the trends are studied and evaluated. Observations and literature reviews suggest MSW making the situation of cholera worse if not causing it. This study has also provided suggestions for getting the situation better in the longer term using available literature and has laid the groundwork for further research regarding the relationship between the two to further understand their significance on one another.*

**Keywords:** Cholera, municipal solid waste, solid waste management, Kathmandu, Leachate, epidemic.

## 1. Background

Kathmandu valley houses over three million people in an area of about 250 mi<sup>2</sup> making it the most populous and dense location in a country of almost 30 million residents. It must also be noted that the valley is also the most developed and urban area of the entire country, thus making it the region with the highest energy consumption, waste production, and economic activity.

Cholera, although in visible decline in recorded numbers in the last two decades, has always had a frightening effect on the Kathmandu public. With countless awareness campaigns and subsidized medicines, the existence and occurrence of the disease are also well understood in the valley. However, the sudden emergence of an epidemic level in the monsoon of 2022 rang a lot of alarm bells and showcased the level of preparedness, or rather the lack of, to

tackle such a disease. At the same time, the horrendous condition of infrastructures related to water, sewage, and MSW was also pretty realized by the people in the valley. MSW management, in particular, has never been regulated to a level of local satisfaction and praise, at least, in recent history. This article evaluates the trend of MSW and Cholera leading up to the event and discusses the correlation between the two. It describes the role of MSW mismanagement by the local authorities inside the valley in aiding the spread of the epidemic. Furthermore, this study also establishes formwork for future research regarding the two topics for proper scientific and policy-making solutions to both problems.

## **2. Introduction**

### **2.1 Municipal Solid Waste (MSW) and MSW Management**

The Asian Development Bank (ADB) describes Municipal Solid Waste (MSW) as the waste from households, commercial and institutional establishments, parks and gardens, street sweepings, and treated hospital waste (ADB, 2013). MSW Management can be explained as the systematic effort or procedure, by the municipal and/or local government, to manage MSW in ways that benefit all the stakeholders involved (Schübeler et al., 1996). There is no single benchmark for MSW and its management, as they depend on factors like location, time, and population, among others. Although, it must be noted that an increase in population and quality of life usually means a larger quantity of MSW and thus the need for better MSW management. It is also undeniably true that mismanagement of MSW can lead to a plethora of socio-economic and health problems (Guerrero et al., 2013).

### **2.2 Cholera**

Cholera is commonly identified as a bacterial disease caused by vibrio cholera bacterium infection of the intestine, resulting in severe dehydration and diarrhea. Cholera is communicable and is spread through the fecal-oral route- directly or indirectly through sources of oral intake like contaminated food and water (Sack et al., 2004). It is considered an endemic disease that has been prevalent in poor, underdeveloped countries in the Asian, African, and Caribbean region since 1817 (Harris et al., 2012). An estimated 2.86 million cases and 95,000 deaths are estimated due to Cholera around the world indifferent endemic countries (Park et al, 2022). This figure is objectively deflated as most cholera cases are unreported due to a variety of reasons including use of contaminated municipal water supplies and also food and raw or undercooked fish and seafood sourcing from water sources polluted with sewage (Legros, 2018.). Cholera is mostly detected in areas with poverty, overcrowding, and very low-quality of water infrastructures, sanitation, and waste management (Mandal et al., 2011). Thus, it is of no surprise that the countries with the highest Cholera cases recently have been India, Bangladesh, Nigeria, and Niger among others (ECDC., 2022).

## **3. Objectives**

This manuscript was prepared amid the Cholera epidemic that occurred in the summer of 2022 in the Kathmandu valley. There was an understanding of how contaminated water

resources and water bodies could cause the disease but not much was being discussed about the potential relationship between municipal solid waste and cholera. With the protests by locals in the area of the only landfill site serving Kathmandu's solid waste leading to open dumping in the streets and corners of the valley corresponding closely to the sudden and quickly spreading cholera epidemic at that time, the possible relationship between the two events was entertained a bit by the public.

There are two major objectives of this article. The first is to study the possible relationship, if any, between the Cholera epidemic and the MSW crisis that occurred in the monsoon of 2022. The second is to encourage and lay the groundwork for future extensive scientific and anthropogenic research regarding the connection between the two.

#### **4. Methodology**

The study was based on two types of information collection: literature review and site visits from the authors. The main source of literature was The University of Kansas Libraries system with assistance from Google Scholar, Google Inc.. The scholarly literature belonged to various journals, written by various authors at different times. The literatures chosen and reviewed were based on MSW and Cholera, and the common links between them were identified and discussed by the authors. Similarly, the data for the 2022 epidemic were sourced from the Epidemiology and Disease Control Division of the Government of Nepal's Ministry of Health and Population: Department of Health Services' daily reports. Popular sources were also applied to provide a better insight of the conditions from the ground level. These include articles by journalists from various reputed media houses. Finally, the authors also observed and evaluated the conditions of MSW management and the epidemic from the front lines and discussed the correlation.

#### **5. Findings**

##### **5.1 Practices of the past**

Kathmandu claims the highest quality and quantity of policies and infrastructures relating to health, education, and sanitation. However, the infrastructures in the valley are far from capable of handling the pressure of the urban sprawl which is visible through sporadic calamities like cholera.

The first recorded case of the Cholera epidemic in Kathmandu occurred in 1823. Subsequent epidemics then occurred in the following years, especially during the monsoon season- which lasted in the valley from June to October. Due to the lack of education, or the suppression of it from the Rana dynasty of the time, Cholera was credited to several unscientific and groundless claims deeply rooted in societal superstitions. However, Kathmandu was already severely overpopulated back then, with a very limited, if not non-existent, sanitary, and waste management system (Robertson, 2020). The influx of a massive number of people from across the country into the valley alongside indifference from the government to solve the health crisis made the situation worse- leading experts to claim that the foundation of the valley itself was contaminated with filth was beyond help unless a

complete upheaval of the society was orchestrated (Gimlette, 1886). After the late 1880s, there existed no report or research regarding Cholera epidemics for almost a hundred years due to political instability and lack of concern from the governing authorities. However, oral history passed on from the generation that lived in that era describes the existence of cholera and the acute effects on people of the era.

Not a lot of factual data can be attained from records relating to Kathmandu. Lack of surveillance and detection has prevented a proper understanding and modeling of the numbers surrounding cholera in the valley. However, a model developed by Ali et al. estimates that 30379 and 911 people are affected and die due to cholera in Nepal, respectively, annually (Ali et al., 2015). Cases of cholera have been detected in the valley almost every year, but no study has been done relating to its trend of it in the valley (Roskosky et al., 2021).

The history of SWM, however, is noted slightly more than that of Cholera in the valley. Almost all the records from 19<sup>th</sup> century Kathmandu suggest that the city was extremely filthy with unmanaged waste reeking the town in all corners (Yoshida, 1994). Before the late 1800s, people were noted to have dumped their waste either in the courtyards in the important Durbar sites or on vacant public lands. The waste dumped in vacant lands was left as they were, but the portion dumped in the courtyards was collected and disposed of by the surrounding local public and through other private initiatives. These were disposed to either a nearby riverbank or vacant public land. The hand of the governing authority isn't visible until 1891 when the then Prime Minister Chandra Shumsher JBR, ascertaining the failing system of public cleaning and realizing the need for a state-sponsored waste collection and disposal, opened the first sanitary office called the *Safai Adda*. Laborers of the *Kuchikar*, *Pode*, *Chyame*, and *Harahurucaste* were employed to do the cleaning and disposal of waste all over the city (Tuladhar, 1996). This system kept continuing steadily until the massive immigration into the Kathmandu valley in the mid-20th century started to take its toll. By the 1950s, the valley had its distinct municipal governments with responsibilities to manage the solid waste produced within their premises, but they were unable to keep up with the huge amount of waste being disposed of due to the high population and industrialization. The Government of Nepal then requested the German government for help in the study and long-term management of MSW in the valley, which was obliged in the form of German Agency for Technical Cooperation (GTZ) in 1980. Under the aid and recommendation from the study conducted by GTZ, an agency under the name of Solid Waste Management Board was established- later renamed Solid Waste Management and Resource Mobilization Center (SWMRMC). The agency was responsible for the collection, segregation, and disposal of solid wastes in certain wards of the municipalities in the valley. A waste processing plant alongside a landfill was introduced to Kathmandu in 1986. This landfill was constructed in *Gokarna* and oversaw massive protests from the inhabitants and mismanagement up until its ultimate closure in 2000 (Pokhrel & Viraraghavan, 2005). Haphazard dumping to nearby rivers and open spaces continued up until 2005 when a temporary landfill in *Sisdole* was introduced when a bigger landfill was in

the works in *bancharedanda*. However, the new landfill hasn't been completed yet and the *Sisdole* landfill is way beyond its carrying capacity. In several instances throughout the years, the residents of *Sisdole* have protested the disposal leading to the haphazard dumping of wastes by the public which then leads to public nuisances and cases of epidemics like that of cholera (Dangi et al., 2017). This has been a recurring theme in the case of MSWM for a good chunk of recent Kathmandu history.

## 5.2 Contemporary Situation

The residents of *Sisdole* protested the latest beginning at the end of April. The Kathmandu valley at present produces approximately 1,200 metric tons of waste in a day- which are first laid down in the Teku Transfer Station and then carried to the landfill via 150 garbage trucks every day. The locals disrupting the flow towards the landfill meant several thousand metric tons being deposited in Teku and other parts of the valley for several months (Poudel, 2022). The Monsoon season set in a week earlier than usual- on the 5<sup>th</sup> of July and was predicted to rain just as much as it did last year (THT, 2022). Similarly, the first recorded Cholera cases appeared on the 16<sup>th</sup> of June. As of the 12<sup>th</sup> of July, there had been 28 cases, which was more than the number of recorded cases in all of 2019, 2020, and 2021.

The correlation between the monsoon season and cholera outbreak is pretty evident and well recorded in the case of the developing countries in South Asia (Emch et al., 2008, 2010; Pascual et al., 2002). However, the case for the correlation between cholera outbreaks and solid waste isn't as much understood by the public as the disease is waterborne. Cholera is caused by the toxigenic bacterium *Vibrio cholerae* serogroup O1 or O139 (CDC, 2022). The bacterium is found in the feces of humans and animals infected by the disease. It is then spread via water or food contaminated by the bacteria (Cabral, 2010). The problem thus lies in how the bacteria reach the water and food medium, and the solution lies in cutting the conveyance. Poor hygiene, sanitation, and waste treatment systems lead to contamination- which explains why Kathmandu is hit by the epidemic so frequently.

Almost all parts of Kathmandu retain a combined sewer system- meaning both stormwater and wastewater flow through the same conveyance system (Nyachhyon et al., 2006). This is of concern as Kathmandu averages rainfall between 0.13 and 0.37 mm h<sup>-1</sup>, which poses dangers in the context of flood in Kathmandu's context (Pokharel & Hallett, 2015), and the only existing wastewater treatment plant in Kathmandu, Guyeshwari WWTP, can treat just 3.24 million liters a day which is less than 25% of the total wastewater produced by the 3 million population of Kathmandu even after disregarding peak flow (Bajracharya, 2021). Simply put, Kathmandu does not have the infrastructure required to treat wastewater potentially transporting cholera bacteria. MSW in Kathmandu eggs on to that as the MSW produced in Kathmandu is not segregated by any authoritative agency. About 66% of Kathmandu's MSW consists of organic waste that could potentially be carrying pathogenic cholera bacteria. Unsegregated waste containing high proportions of organics would usually get dumped in the *Sisdole* landfill- the leachate of whose would go untreated, infiltrate water resources, and infect locals with various diseases including cholera (ADB, 2013;

Baidar, 2022). With the current situation of open dumping of MSW in the streets, the pathogens have an even greater chance of contact with the public which is made worse by the monsoon season rain (Ross, 2011). Furthermore, MSW is also responsible for the clogging up of several stormwater inlets and conveyance systems that lead to the flooding of not just urban rainwater but also wastewater. The leachate from the dumps in the street doesn't just infiltrate the river but also groundwater. (Han et al., 2016) Similarly, up until the temporary restriction of the sale of street food from the 29<sup>th</sup> of June, many food stalls could be in the locality of dumpsites. It isn't just food stalls, but also local retail businesses, small-scale industries, and street dwellers who could be found around the dumps across the valley. Individuals in the vicinity make direct or indirect contact with the waste and rise the prospect of contamination. The locals' protest in Sisdoile has also led to the return of dumping of household waste in the nearby river by the public.

## 6. Suggestions/takeaway from the study

Issues with MSW have been common knowledge since the boom of immigration and urbanization in Kathmandu for a very long time as evidenced by reports from the 19<sup>th</sup> century. Throughout all these years, a definitive solution to the plight has never been executed to even a small portion of success due to a variety of reasons. One of many such reasons can be attributed to the lack of implementation of the evaluations that arose from several scientific studies done regarding the topic. It has been identified, through various examples in history, that the governing authorities do not readily follow the literature regarding solutions to the problem. The topics of management of MSW that have scientific backing but are neglected by the authorities range from formal recycling, segregation, biological treatment for organic waste, and organized dumping to infrastructure restructure among others. The solution is for this system of negligence and laxity to be shed by the governing authorities and a newer system of better collaboration with scientists to be executed. Only when the authorities are diverted to scientific and systematic solutions will the plight be reduced. The details of such a system are beyond the scope of the study and require further studies to build them.

Another solution to the burgeoning MSW problem is proper public participation. As most of the MSW is produced from individual homes and small businesses, it is worth the effort and capital invested to entice and encourage people into performing small tasks that could help the management of MSW on a macro level (Dangi et al., 2011). These could include segregation of waste, reuse of plastic and glass products, and operation of compost bins, among others. It must also be noted that these efforts must be encouraged, incentivized, and even subsidized if possible. Recently, some municipal governments inside the valley have set up a rule to segregate waste under the pretext of certain penalization if it's not achieved. However, the use of force or coercion using punishments, fines, and threats won't work as well as incentives will to raise such public sentiments (Haque et al., 2022). The governments must be smart in avoiding such decisions that could lead to public unrest and dissatisfaction.

Finally, another feasible solution could be the integration of the informal waste sector into the formal one. The presence of informal waste workers (IWWs) is undeniable in the valley and efforts can be led from the government's side to evaluate and regulate the processes that the informal sector run. There are estimated to be 7,000 to 15,000 IWWs in the Kathmandu valley (Black et al., 2019). IWWs are also the population that is the most under the threat of diseases spread by waste like cholera. The unprotected manner in which the informal workers operate and dwell makes them not just vulnerable to the disease by also susceptible to transmission (Sapkota et al., 2020). There have been cases around the world where informal waste work was regulated and conducted systematically in sync with the government's plans and policies and have been successful in bringing positive changes (Dias, n.d.; Masood & Barlow, 2013). The study of such integration is beyond the scope of this review, but studies like such should be prioritized and entertained by the government.

## 7. Conclusion

The cholera epidemic of 2022 is a wake-up call for a lot of people that don't believe an epidemic could hit an urban area like the Kathmandu valley. It is also a reminder to the locals that the issue of sanitation and hygiene is still at large and needs to be addressed as immediately, effectively and efficiently as possible. Amid a heated MSW management crisis brought upon by decades of mismanagement and negligence by the government, the cholera epidemic has made experts and the public alike think if the two are related to each other somehow.

This article has discussed how MSW and its contemporary conditions could have aggravated the epidemic in three particular ways: public participation, technical implementation of solid waste management strategies, as well as transition of informal waste management sector to formal body with regular inspection. Thus, it has suggested ways to remedy the situation with a focus on MSW management. This article has also provided footing for further study on specifics of these topics and discussed the roles further studies would have in rehabilitating Kathmandu's waste and epidemic situation.

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