



Geotechnical and Geo-environmental Assessment of Amin Bazar Solid Waste Disposal Site, Dhaka, Bangladesh

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1. Introduction

Being a megacity, Dhaka has a population of approximately 25 million. Over 6,500 tons of solid trash are produced daily in Dhaka; the UN predicts that by 2032, this amount may increase to 8,500 tons (United Nations Bangladesh, 2024). The two city corporations, Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC), oversee the collection of waste and transport it to landfills such as the Amin Bazar (DNCC) and Matuail (DSCC) landfills for disposal. This article focuses on the Amin Bazar waste disposal site only. Since 2007, DNCC's main landfill is the Amin Bazar Waste Disposal Site, which is located close to Gabtoli on the city's western edge. The site is situated in a geotechnically and environmentally unsuitable location, as the area is low lying and surrounded by marshy land. It has rapidly expanded both horizontally and vertically over the past decade as a result of Dhaka's rising waste output (Figure 1). The wastes are being dumped continuously across the entire site rather than undergoing any remediation to date. The expansion of the site has drastically changed the region's hydrology and geomorphology, and urgently needs geotechnical solutions.



Figure 1. Waste Hill at Amin Bazar Waste Disposal Site, Source: Shutterstock

2. Satellite Imagery Observation

The satellite imagery (Figure 2) reveals a substantial increase in coverage by landfill of what was once a low lying and groundwater recharge area of Dhaka.

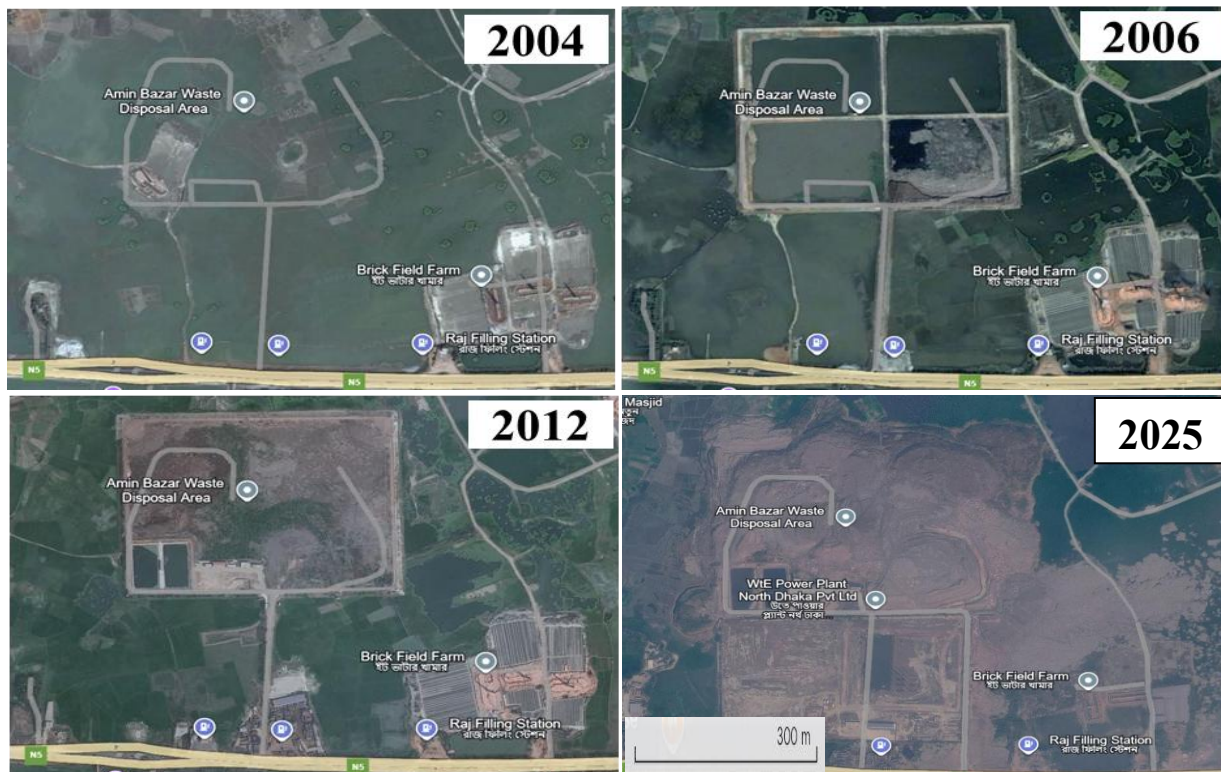


Figure 2. Historical Imagery of Amin Bazar Waste Dumping Site, Source: Google Earth Pro



3. Impact on Dhaka's Hydrology and Hydrogeology

As Dhaka city lies above the impervious Madhupur clay soils and most of the ground surface is covered with buildings, asphaltic roads, concrete pavements, etc., rainwater cannot directly infiltrate to recharge the groundwater. The aquifer below Dhaka city is therefore recharged due to the lateral inflow of water from the outer edges of the city. The Amin Bazar area is also a recharge area of Dhaka city's aquifer. The chosen waste disposal site at Amin Bazar is the floodplain of the Turag River. During the monsoon season, leachate runoff combines with the river and nearby drainage canals and pollutes the surface water, eventually penetrating groundwater and degrading the quality of the water. The lack of an engineered liner and a fully operational leachate collection system on the site has also made it easier for pollutants to infiltrate vertically, putting the upper aquifer at risk and perhaps degrading the quality of Dhaka's peripheral groundwater. Both the surface and groundwater are affected due to the unsuitability of the site and poor management, ultimately affecting human health.

4. Environmental Consequences

The growth of the Amin Bazar Solid Waste Disposal Site is severely damaging to the environment. Large amounts of leachate are produced as a result of the ongoing disposal of municipal solid waste; this leachate seeps into nearby soils and shallow aquifers, increasing the concentrations of organic contaminants and heavy metals. Methane, carbon dioxide, and hydrogen sulfide emissions from the site also contribute to air pollution, endangering both the local climate and human health. In nearby floodplain areas, habitat disturbance and vegetation loss have decreased biodiversity. In order to reduce persistent environmental risks and long term consequences, these effects together demonstrate the vital necessity of integrated geo-environmental management, which includes understanding the geology, hydrogeology, and hydrology of the site, developing a design with a proper leachate collection system, and application of ecological restoration techniques.

5. Solutions to the Problems

A combination of geotechnical engineering, hydrogeological control, and environmental management is crucial to reducing the continuous degradation of Dhaka's groundwater and wider environment. The problems can be solved by taking three different types of measures. These are-



1. Closure of this site and redevelopment of another in a suitable place and in an engineered way.
2. Waste reduction, reuse, recycle and recover (waste to energy).
3. Improvements to the existing dumping site.

To improve the existing landfill; following measures can be taken are

1. Base Liner Installation: Composite clay– High Density Polyethylene (HDPE) liners can be installed to avoid leachate intrusion during future extension of the site.
2. Layering of Waste: To reduce leachate percolation and increase overall stability, waste can be deposited in monitored consecutive layers with low permeability clay layer in between.
3. Slope Reinforcement: Geogrid and geotextile layers can be used to stabilize side slopes of the waste hill (Figure 2) and stop uncontrolled mass movement.
4. Leachate Collection and Treatment: Collection of leachates via a piping system sloped to drain to a central collection point for treatment.
5. Diversion of Overflow: Peripheral drainage canals can be built to stop runoff and leachate from combining with marshy areas.
6. Groundwater Monitoring Wells: Regular water quality testing to monitor groundwater levels and track contaminant migration.
7. Remote Sensing Based Monitoring: Use of drones and aerial imagery to track landfill expansion, detect illegal dumping, and evaluate leachate contamination with surface water.
8. Vegetative Capping: Designed final cover with low-permeability soil and vegetation to minimize infiltration and odour. Capping can be installed progressively as landfill development proceeds.
9. Gas recovery wells: Methane gas is flammable. Produced gas by decomposition of wastes can be collected and used for electricity generation.
10. Aerobic Composting: Organic solid wastes can undergo aerobic composting to make it saleable compost.

6. Conclusion

The long-term transition of Amin Bazar Waste Disposal Site serves as an example of how urbanization is interlinked with environmental and hydrological degradation. The location presents



increasing risks to Dhaka's hydrology and hydrogeology if the previously discussed measures are not adopted right away. A more sustainable method of disposing the urban garbage may be guided by combining environmental engineering techniques, geotechnical stability, and remote sensing-based monitoring discussed above, protecting both land and life. Additionally, collection, sorting, transport and deposition of trash according to its kind and then properly treating, following 4R's concept (reduction, reuse, recovery and recycle) may greatly lower the overall waste load while encouraging sustainable waste management. When the above approaches are combined, the Amin Bazar site may be transformed from an unregulated landfill into an eco-friendly waste management model for growing megacities like Dhaka.

References

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