



BRAC SCHOOL OF PUBLIC HEALTH
JAMES P. GRANT

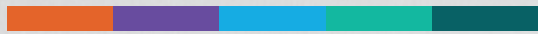
CELEBRATING TWO DECADES OF ACADEMIC & RESEARCH EXCELLENCE (2004-2024)



**Imperial College
London**



POLICY BRIEFS: PATHWAYS TO EQUITABLE HEALTHY DHAKA



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Pathways to equitable healthy cities is a global partnership that aims to improve population health, enhance health equity and ensure environmental sustainability in cities worldwide through the co-production of rigorous evidence with policy and civil society partners in the towns in five countries.

UK
(London)

CHINA
(Beijing)

GHANA
(Accra, Tamale)

CANADA
(Vancouver)

BANGLADESH
(Dhaka)

HEALTH CHALLENGES OF CITY DWELLERS

- Unplanned housing, toxic substances in the air and water, and lack of sanitation and safe roads expose the population of Dhaka city to health threats such as water-borne diseases, respiratory difficulties, road fatalities and non-communicable diseases.
- To reduce the inequalities and realize Sustainable Development Goals by 2030, policy movements are needed to minimize these urban health threats. Due to a lack of evidence, influencing policymakers remains a challenge.
- The information available in population census and other large-scale surveys is insufficient to modify policies. To address this matter, BRAC James P Grant School of Public Health (JPGSPH), BRAC University partnered with the Wellcome Trust through the Imperial College London, envisioning a healthy Dhaka city for all, regardless of one's socioeconomic status.

The Wellcome Trust funds our research through the Our Planet, Our Health scheme.

VISION

The vision is to provide timely, rigorous scientific evidence on how urban change and development can be directed and managed to positively impact the health of people, communities, and the planet and enhance health equity.

RESEARCH AREAS

We used diverse data sources, especially emerging open and big data, and novel methods for data integration and visualization to characterize cities' dynamic social, physical and natural environments, people's experiences of these environments, and their health. We also used interdisciplinary methods from social sciences, engineering, environmental science and epidemiology to evaluate how urban policies and programmes will impact the urban environment and population health through a lens of health equity. The Pathways Project focused on the following areas:

- **Big Data**
- **Knowledge Co-Production**
- **Health Outcomes**
- **Housing and Neighborhood**
- **Measurement and Monitoring**
- **Poverty and Inequality**
- **Transport and Mobility**
- **Water, Sanitation and Waste Management**

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Healthy Dhaka: Charting Progress towards Sustainable Solid Waste Management

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BACKGROUND

Rapid urbanization and industrialization, symbols of global advancement, have pushed Dhaka towards rapid economic and social progress. However, this trajectory of development has been paralleled by a mounting challenge: the management of increasing solid waste. As the city flourishes with prosperity, more waste is being produced, which strains the city's current systems and creates interconnected challenges like public health and environmental integrity. The nexus between urbanization, consumption patterns, and waste generation underscores the urgent need for implementation of effective waste management strategies in Dhaka.

OUR STUDY

The project conducted comprehensive research on various aspects of solid waste management in the city. A multi-method approach, including policy analysis, field visits, workshops, geo-spatial analysis, and surveys was taken for the research.

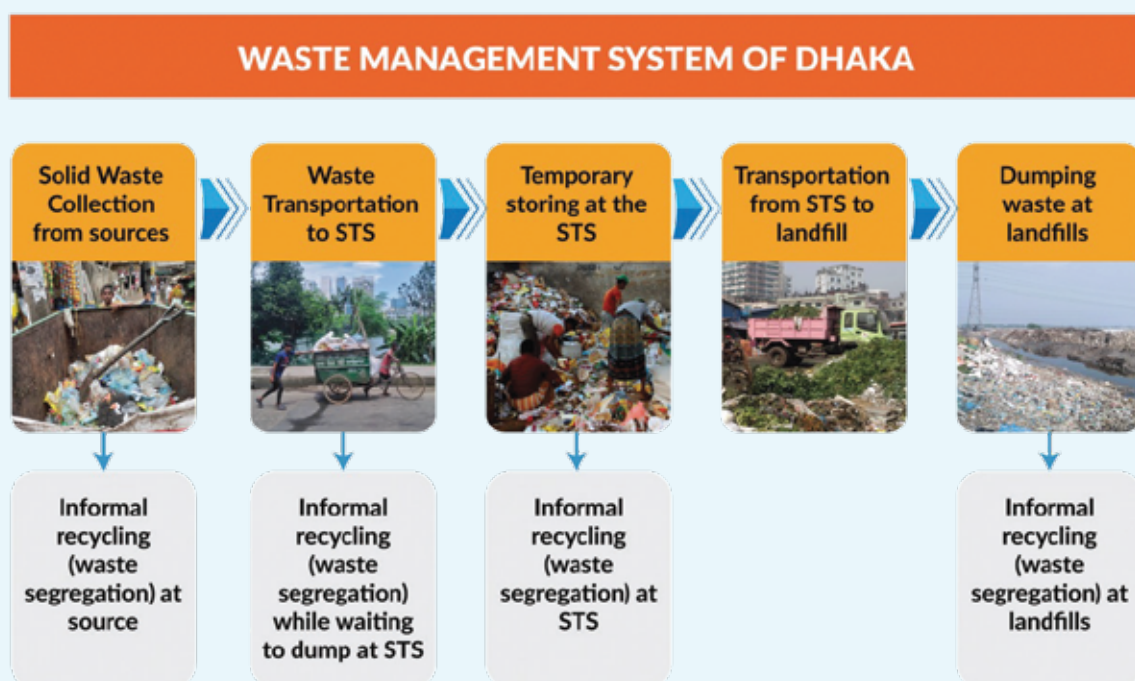


Figure 1 Informal recycling within waste management

KEY FINDINGS

Governance Challenges to Solid Waste Management:

The research identified critical gaps in policy implementation and highlighted key findings essential for informing targeted interventions.

The current waste management system in Dhaka is facing issues in its effectiveness, and policies and action plans have not been adequately implemented due to challenges such as technical difficulties, resource constraints, and a lack of awareness and coordination. Improper solid waste management practices of the secondary transfer stations (STS) and landfills cause adverse environmental effects through leachate percolation, waste incineration, and vector breeding. Addressing these challenges requires initiatives such as community-led sanitation approaches, subsidized waste collection fees, and rigorous enforcement of waste segregation practices.

Waste Collection:

Waste collection is the first and most important step of waste management. Despite being introducing the 3R policy, wastes are not separated from source. This creates issues while segregating, recycling, and disposing at later stages.

There are more than 100 Secondary Transfer Stations (STS) in all of Dhaka city, but their capacity, placement, and waste management system are still outdated and unplanned, given the challenges relating to finding suitable land and space for setting up the STSs. Our study found at least 2 STSs located within 50 meters of educational institutions and 12 STSs within 100 meters, posing potential health risks to thousands of students (Figure 2 & 3).

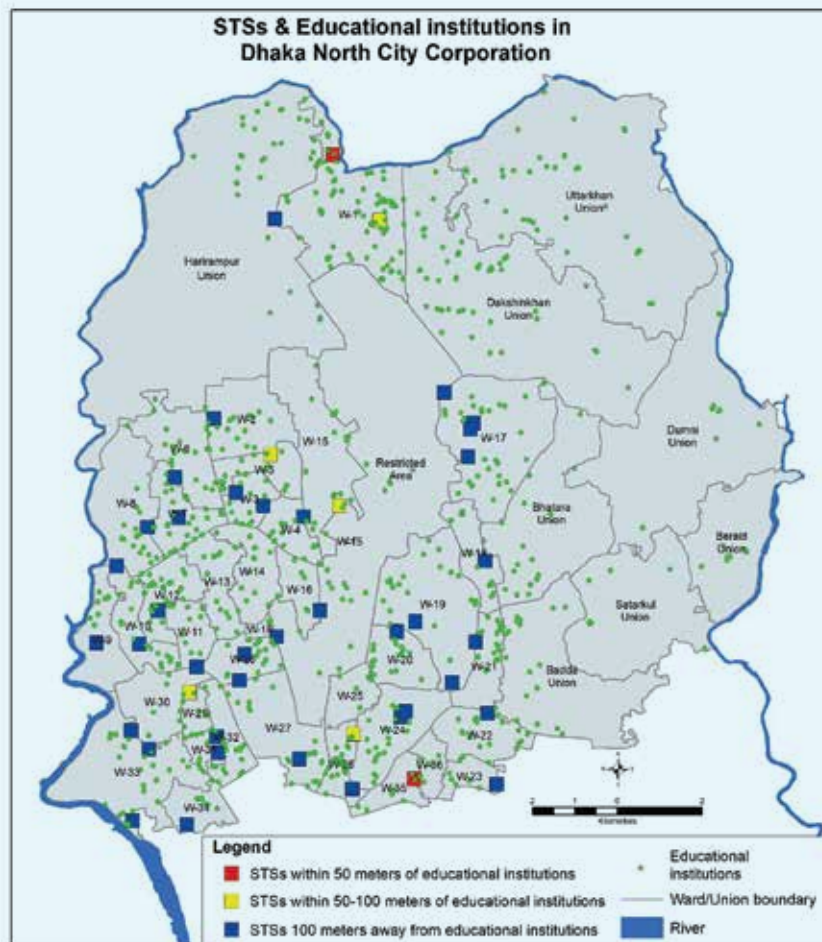


Figure 2 STS near Educational Institutions in DNCC

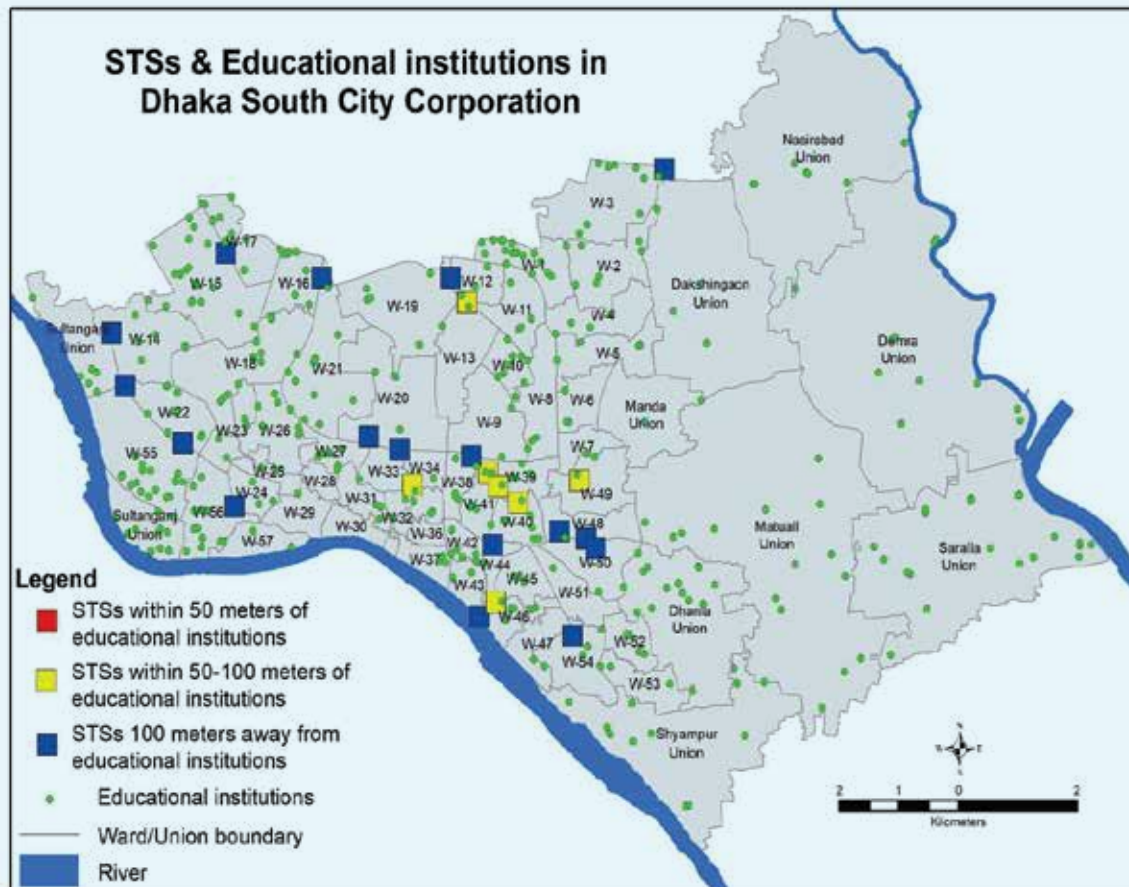


Figure 3 STS near Educational Institutions in DSCC

Additionally, despite lacking proper facilities for handling medical waste, at least 7 STSs are within 100 meters of hospitals and 1 STS within 50 meters. To promote long-term viability, there is a pressing need for improved primary waste disposal practices at strategically selected locations.

Dhaka's waste collection system encounters irregularities, especially in informal settlements, leading to environmental pollution and health risks. Addressing this necessitates improved collection frequency, alongside enhanced guidance on waste reduction at the household level.

Waste Recycling:

Informal recycling practices prevail in Dhaka, at almost every stage of waste management (Figure 1). It indicates the need for formalized recycling initiatives, including household waste segregation, incentivized recycling programs, and comprehensive waste treatment strategies. Waste recycling has the potential to finance the majority of the management by the use of proper technologies and innovative business models.

Waste Disposal:

The issue of waste disposal and its environmental impact has been widely acknowledged, but a sustainable solution is yet to come. Waste spillage from landfills in Aminbazar has been identified as polluting the Turag River and its surroundings, indicating the urgent need for proper waste management and environmental law enforcement.

The observance of uncollected waste being openly dumped in open spaces is a significant concern, leading to air,

water, and soil pollution. Furthermore, waste disposal in informal settlement areas has been reported to be worse than in other urban areas. In addition, the widespread dumping of waste into rivers and public places is not in line with existing waste management policies. These findings demonstrate the pressing need for improved waste disposal practices and environmental enforcement measures.

Informal Child Labor:

Child labor remains prevalent in waste management activities, exposing children to health hazards and injuries. Our study found more than 2000 children (aged between 5 and 17 years) working in the STSs in waste collection, segregation, and recycling (at more than 90 STSs in 2022). These children are at risk of severe health hazards (52% had respiratory problems, 92% had skin problems) and injury (78% had cut marks) through their informal employment. The main pathways for these children to start working in this sector are flexible employment, family members' involvement in the sector, and no previous knowledge or experience is required. Mitigating this issue demands stringent enforcement of labor laws and alternative livelihood opportunities for vulnerable populations.

Health Concerns:

Open dumping, storing waste in STSs leachate contamination, and inadequate protective measures pose significant health risks to both waste workers and nearby communities. Both groups of people suffer from bronchial diseases, pneumonia, diarrhoea, itching problems, headache and appetite loss while waste workers also face occupational injuries. Addressing these concerns requires improved waste management practices and enhanced occupational safety measures.

POLICY RECOMMENDATIONS

Solid waste management in Dhaka is intertwined with broader environmental, social, and economic dimensions, necessitating comprehensive strategies and policies. Proposed interventions include community-led sanitation programs, strengthened waste collection regulations, and the establishment of common collection points in informal settlements. Additionally, holistic master planning integrating various domains impacted by waste management is essential for achieving long-term sustainability.

For further details, see our published paper:

1. Jerin, D.T., Sara, H.H., Radia, M.A., Hema, P.S., Hasan, S., Urme, S.A., Audia, C., Hasan, M.T. and Quayyum, Z. (2022). An overview of progress towards implementation of solid waste management policies in Dhaka, Bangladesh. *Heliyon*.
2. Urme, S. A., Radia, M. A., Alam, R., Chowdhury, M. U., Hasan, S., Ahmed, S., Sara, H. H., Islam, M. S., Jerin, D. T., Hema, P. S., Rahman, M., Islam, A. K. M. M., Hasan, M. T., & Quayyum, Z. (2021). Dhaka landfill waste practices: addressing urban pollution and health hazards. *Buildings & cities*, 2(1), 700–716. <https://doi.org/10.5334/bc.108>
3. Sara, H., Alam, R., Hasan, T., Quayyum, Z., & Jerin, D. (2020). Exploring health risk of people living near the Secondary Transfer Stations and Landfills in Dhaka. *European Journal of Public Health*, 30(Supplement_5), ckaa166-157.
4. Sara, Hasna Hena, Quayyum, Zahidul, Bayazid, Anisur Rahman and Rahman, Monybur. (2022). Informal child labor in Dhaka City: Exploring the pull factors and health sufferings of children involved in waste management. Presented at the RTA-HTRI Conference, Online Event, June 2022.

Mapping Urban Waterlogging Zones of Dhaka city: Vulnerability Assessment through Different Modeling Approaches

Study Research Team: In alphabetical order

Adrian Butler, Ben Howard, Hasna Hena Sara, Khadiza Tul Kobra Nahin, Majid Ezzati, Marzuka Ahmad Radia, Md Tanvir Hasan, Rafiul Alam, Simon Moulds, Wouter Buytaert, Zahidul Quayyum



BACKGROUND

Waterlogging triggered by flood itself is multidimensional in terms of its cause of creation and impacts on the city people. Dhaka city being the center of the most development activities throughout Bangladesh, is tremendously affected by waterlogging during monsoon season. Experts believe that embankments built to protect flood inadvertently led to internal waterlogging and drainage congestion during heavy rainfall in the western part of Dhaka for the lack of adequate pumping system and a poor drainage management. While streams overflow commonly floods areas and subsequently subsides, this isn't always the case for some low-lying communities; especially the informal settlements or slums, which endure prolonged waterlogging.

Here, we present an attempt to detect waterlogging zones of Dhaka city with the application of GIS-Remote sensing techniques as well as HEC-HMS (Hydrologic Modeling System) and HEC-RAS (Hydrologic Engineering Center's River Analysis System) modeling. Vulnerable areas were identified by overlaying population density, location of slums, healthcare, poor housings and secondary transfer stations (STs) of waste, and elevation data with the modeled waterlogging maps.

OUR STUDY

GIS based modeling suggests that south and south-western parts of Dhaka were more susceptible to water logging hazards. Almost 30-40% of Dhaka belongs to the high/very highly vulnerable zone where 53 wards are situated. Greater number of slum households were observed within high to very high water logging vulnerable zones with approximately 70% of poorly structured households. Besides, the maps indicate that population density is higher in the waterlogged zones than in the non-waterlogged zones. Moreover, the slums were densified in the “very high” waterlogged areas.

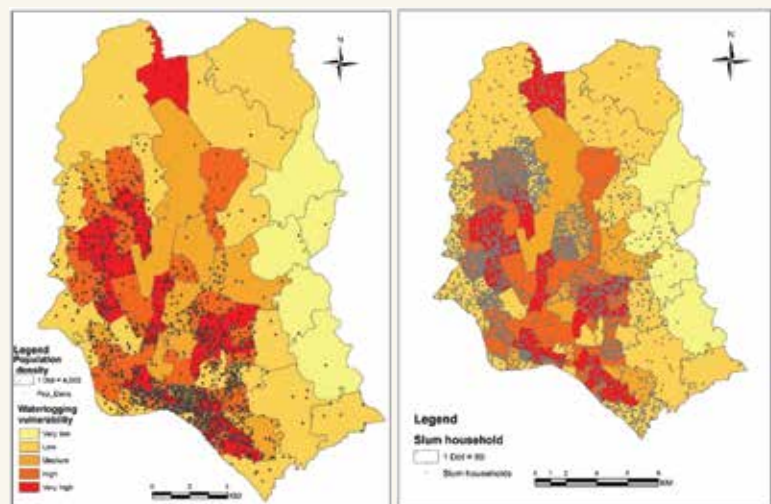


Figure-1 Waterlogging zones based on GIS based analysis showing vulnerable zones respect to population density and slum households

HEC-HMS and HEC-RAS model-based analysis revealed that the areas adjacent to the northwestern, northeastern and southeastern boundaries of the city are the most severely affected zones. During maximum waterlogging situations, a few sites along the Buriganga river in the southwest, boundary regions along the eastern section of the city, and the border line in the northern region along the Tongi canal were inundated which is about 35% of the total area of the city corporation boundary. Furthermore, the high population density and prevalence of slum areas in the southwestern and southeastern waterlogging zones represent hotspots of vulnerability in the city. Low elevation in the northwestern waterlogged zone leaves it vulnerable to extended periods of waterlogging, introducing significant risks for the slum households located in this area.

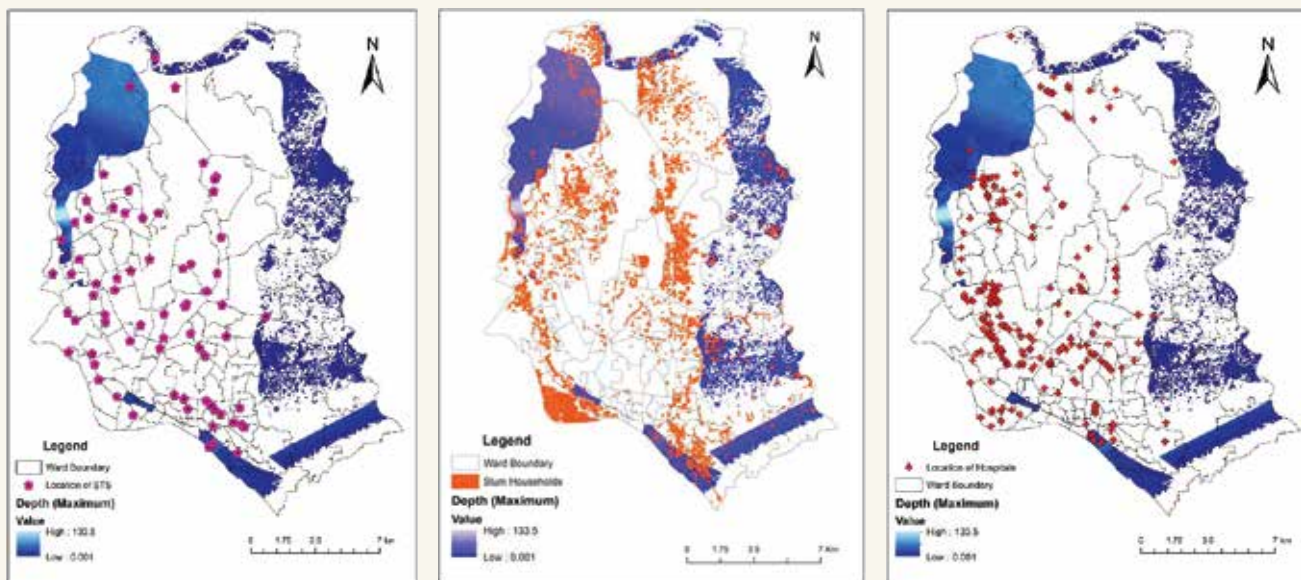


Figure-2 Waterlogging zones based on HEC-HMS and HEC-RAS modeling showing vulnerable zones and location of STS, Slum households and hospitals

The waterlogging of STSs in southwestern areas of the city introduces the potential for open waste contamination, posing a particular threat to the health of inhabitants. Our studies provide a vital spatial characterization of waterlogging and vulnerability in Dhaka city, which can be used to improve the drainage system in the highly waterlogged zones and reduce the health risks experienced by city dwellers. Lack of proper planning in urbanization has created development as well as public health concerning issues for the city dwellers through serious flood and extended inundation periods. Rainfall-runoff during monsoon lead to stream overflow which ultimately results in waterlogging due to poor managed infrastructure in Dhaka city.

POLICY RECOMMENDATIONS

A comprehensive plan and design is required for Dhaka city for an efficient stormwater drainage system taking into account the anticipated climatic conditions. It is imperative to regularly perform maintenance and cleaning of drains, while also removing any illegal or unnecessary structures, particularly in locations that are at high risk. There is an immediate need for a flexible approach to tackle the changing characteristics of floods in the future. Adopting the idea of a sponge city in metropolitan areas could be crucial in efficiently controlling this threat. Furthermore, it is essential to do additional study in order to investigate comprehensive strategies that incorporate several measures, to address this urgent issue effectively. With a view to providing more targeted policy recommendations, our BRAC JPGSPH team is eager to engage in studies targeting Dhaka's waterlogging problem through utilizing the potential of high-resolution datasets.

This policy brief is drawn from the study conducted by BRAC JPGSPH and phase-1 of the study can be found here- R Alam, Z Quayyum, S Moulds, MA Radia, HH Sara, MT Hasan & A Butler. (2023). Dhaka city water logging hazards: area identification and vulnerability assessment through GIS-remote sensing techniques. Environmental Monitoring and Assessment.

Public Engagement in Addressing the Waste-Induced Waterlogging in Dhaka City: Engaging the Community and School Kids

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The Pathways Project Team at BRAC James P Grant School of Public Health (BRAC JPGSPH), BRAC University has worked on waste management and waterlogging, identifying vulnerable zones and associated risks for residents, using GIS and remote sensing techniques. Researchers found improper waste management is one of the key reasons contributing to Dhaka city's waterlogging problem.

In this context, a pilot study¹ was conducted, engaging the students, teachers, and the community in addressing the problem of waste-induced waterlogging and fostering community participation and action for sustainability and health (SDG 3).

OBJECTIVES

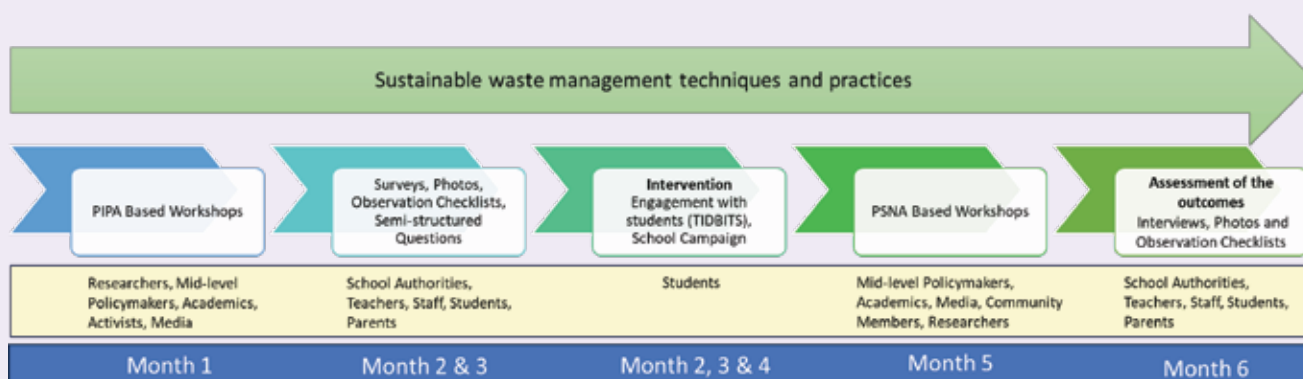
1. Raise awareness of sustainable waste management practices, increase dialogue, and stimulate debate for concrete and bottom-up action on environmental sustainability and health addressing SDG 12.4.
2. Co-produce knowledge and co-design communication materials for the interventions with the target population and policy partners at the local and national levels.
3. Encourage media coverage and communication about evidence-based and sustainable waste practices.

TARGET POPULATION

The target population for addressing waterlogging issues in Dhaka's Badda and Mirpur zones included students from grades 6 to 10, teachers, school staff and parents from nine private higher secondary schools. These zones were identified as the most vulnerable to waterlogging. The schools comprised a mix of three English, five Bangla and one following both English and Bangla National Curriculum. Additionally, community members, shopkeepers residing near the schools, media, activists, researchers, and mid-level policymakers were also engaged through different sessions and coproduction workshops facilitated by PIPA (Participatory Impact Pathways Analysis) and PSNA (Participatory Social Network Analysis) techniques. This comprehensive approach aimed to raise awareness, develop action plans, and advocate for effective solutions, addressing both immediate and long-term concerns.

¹ Pathways to Equitable Healthy Cities: Public Engagement on Waste Management and Waterlogging in Dhaka City

METHODS



*PIPA-Participatory Impact Pathways Analysis

*PSNA-Participatory Social Network Analysis

OUTCOMES OF THE INTERVENTIONS

- The school campaign initiative engaged 1,300+ students, which in turn reached out to an additional 600 students and over 600 community members.
- Co-developed interventions and awareness materials: Participants cleaned their schools, roads and markets, held awareness sessions with juniors, surveyed local vendors and had question-answer sessions with the guardians, prepared posters & flyers, held rallies, provided bins in the nearby communities, staged demonstrations and filmed drama.
- Students maintained cleanliness; community members used bins, and parents improved waste disposal practices, resulting in cleaner schools and surroundings.
- Stakeholders recommended strategies for different solutions and took action plans in Coproduction workshops.

RECOMMENDATIONS FROM THE PILOT STUDY

Consolidating the discussions from the interactions and engagement with the target people into key considerations yields the following actionable recommendations:

1. Celebrate cleaning day in schools either weekly, bi-monthly, monthly, quarterly, half-yearly or yearly.
2. Instruct in assembly on waste disposal and littering practices:
3. "To protect our environment and health, we must all properly dispose of our trash/waste in designated bins in classrooms, schools, streets, and homes."
4. Inclusion of small projects relating to proper waste management in the extracurricular activity classes.
5. Provision of fines or penalties for untidiness and waste littering (suggested by many students).
6. Form school clubs with teachers and students to maintain cleanliness and engage with the community.

Endorsing a document with these actionable points within the school regulations sets a foundation for change. Scaling this nationwide with government endorsement could enhance effectiveness, ensure wider impact, and foster regularity. Respondents have also advocated for extending these successful awareness campaigns led by school children to vulnerable regions.

Spatiotemporal Variability of Urban Greenspace and Surface Temperature in Dhaka City: A Public Health Aspect

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BACKGROUND

Urban greenspaces can affect the physical and mental health of city residents and they can also contribute to improving urban environmental quality in ways that can benefit human health. Dhaka, a megacity with over 22.4 million residents, has progressively lost its greenspace over the past decade as the city has grown and urbanised. Our study evaluated the availability and accessibility of greenspace considering its population and residential areas, as well as assessing the changes to greenspace in the last 30 years throughout the city. We generated geospatial maps of greenspace distribution and accessibility as well as vegetation, land surface temperature and humidity in different years. This study provides noteworthy information on the lack of greenspace throughout Dhaka city.

We utilized secondary data from the 2011 Census and areal imagery to perform the analysis for city wards, the smallest administrative unit, using ArcGIS software. Accessibility to greenspace was measured with 100-meter and 300-meter buffer zones, and a total of 56.5 square kilometers area of 77.47 square kilometers of residential area fell under these territories. Changes in vegetation were obtained using Normalized Difference Vegetation Index (NDVI) for the years 1990, 2000, 2010, and 2020, and a high level of loss in vegetation was observed. Land Surface Temperature (LST) and Normalized Difference Moisture Index (NDMI) were used to assess the temperature and humidity for the same years.

OUR STUDY

We measured that Dhaka has 2.24% greenspace coverage and only 2 wards out of 110 have greater than 20% greenspace coverage. A highest estimate of 0.003207 square meter per capita greenspace was found at ward-46, which does not even meet the minimum health standard. Surprisingly, 26 wards had no coverage of greenspace at all, among which 22 wards were from DSCC (Fig-3). Nonetheless, the total coverage of greenspace is less in DNCC compared to DSCC. From the analysis it was observed that <25% area of the city fell under 300 meters buffer zone of green and open spaces

Increased temperature and decreased humidity were observed in Dhaka city from 1990 to 2020, in a level that may adversely impact on the city population's public health. Drastic changes in land surface temperature (LST) were observed in the last 30 years. The highest value of temperature increased from 25oC to 31.5oC in Dhaka city from 1990 to 2020. The lowest value of temperature increased from 10.82oC to 18.78oC in the mentioned period. The zonal statistics showed that both the maximum and minimum value of temperature increased in 99.7% area of the city in 2020 compared to 1990. Similarity in temperature rise was observed in all the wards where maximum range of vegetation had decreased.

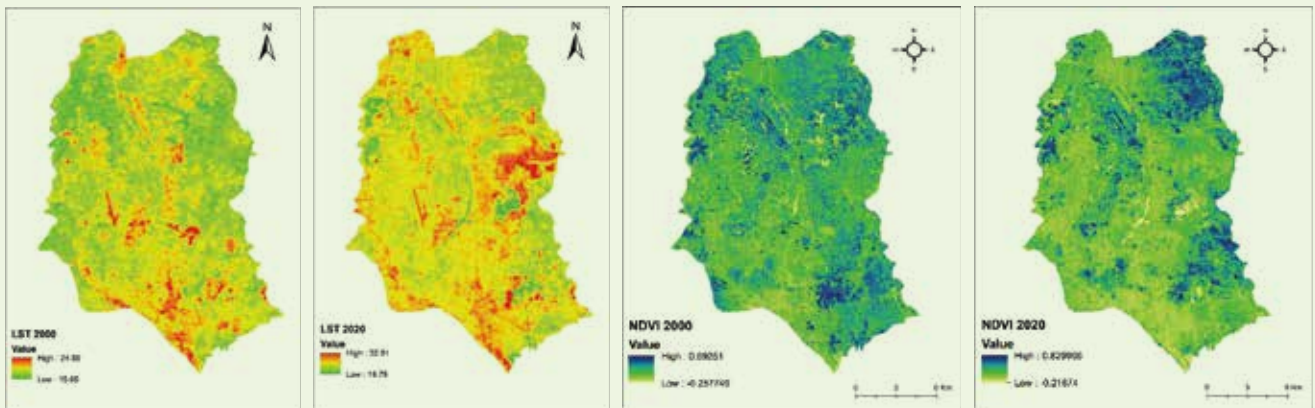


Figure-1 Changes of Land Surface Temperature (LST) and Changes of vegetation over the years (2000 – 2020)

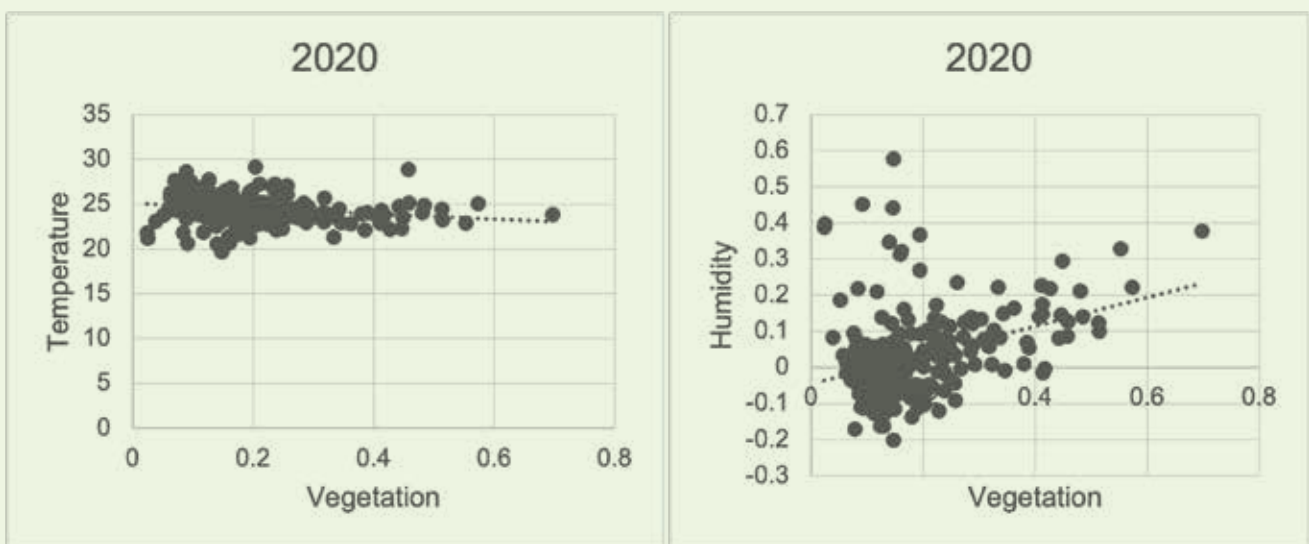


Figure-2 A negative correlation between temperature – vegetation and a positive correlation between humidity – vegetation are found from analysis

POLICY RECOMMENDATIONS

In terms of policy recommendations, it is advisable to create additional green areas to provide a uniform distribution of urban greenspaces across Dhaka city. Moreover, it could be advantageous to establish a uniform criterion for the extent of greenspace and rooftop gardening coverage for each ward. In addition to the technological advancements that promote green infrastructure, urban green space also acts as an indication for tackling climate change and other urban equity challenges, including access, inclusion, and potential discrepancies in opportunities. In light of the climate crisis and the Sustainable Development Goals (SDGs), it is crucial to thoroughly study the political aspects of managing urban green spaces. Besides, the relationship between greenspace and urban heat stress should be thoroughly examined in light of future climatic scenarios, to which BRAC JGSPH can contribute significantly with its competence in spatial analysis and modeling for the real time analysis.

For further details, see our published paper:

KTK Nahin, HH Sara, KR Barai, Z Quayyum, J Baumgartner. (2023). Spatiotemporal Variability of Urban Greenspace and Surface Temperature in Dhaka City: A Public Health Aspect. *The Empathic City: An Urban Health and Wellbeing Perspective*, 143-169.

Small Area Poverty Estimation in Urban Dhaka

Study Research Team: In alphabetical order

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BACKGROUND

A large proportion of the Bangladesh's urban population is concentrated in Dhaka, the capital city, of which 35% are poor. The average income in Dhaka is relatively higher than the rest of the country, the reason it attracts migrants is where they see opportunities to earn to increase livelihood. In contrast, poor-rich inequality is the highest in Dhaka than anywhere else in the country, and over 90% of Dhaka's urban poor lack secure tenure and cope in poor living conditions (slums) with high cost of living.

The data from national and sub-national household surveys often lack a sufficiently large sample size to generate accurate and direct estimates of poverty for smaller geographic domains in a fast-growing city like Dhaka.

OUR STUDY

We examined inequalities in slum and non-slums areas through small area estimation techniques to identify the poverty prone areas in Dhaka city using Household Income Expenditure Survey (2016) and Census data (2011). We focused on the distribution of poor versus wealthy households over three metrics that represent access to improved quality of life. To do so, we used well-established small-area estimation techniques to develop a representative dataset of the distribution of wealth in Dhaka's 110 wards. From this, we estimate the percentage of population in each ward living in poverty (bottom 20%), extreme poverty (bottom 5%), wealth (top 20%), and extreme wealth (top 5%). We examine the spatial distribution of these income classes in relation to the three quality-of-life metrics: proximity to greenspace, access to healthcare facilities, and distance from highly polluting brick kilns. The quality-of-life metrics plays major role in determining the living condition of urban dwellers in terms of socioeconomic and wellbeing perspective.

KEY FINDINGS

We found that the high numbers of slum households can be found in wards with the highest number of extreme poor or poor rather than the wards with highest proportion of extreme rich or rich. In particular, the highest density of slum households was found in Ward-19, 20, 22, 4, 3, 5, 46. Besides, ward-79, 80, 81, 82, 69, 71, and 67 these are the most densely populated areas which includes Sutrapur, Kotwali and few areas without embankment protection e.g., Manda, Sarulia. Ward- 04, 05, 07, 10, 12, 13, 42, 43, 44 have high population density with a large number of poor populations.

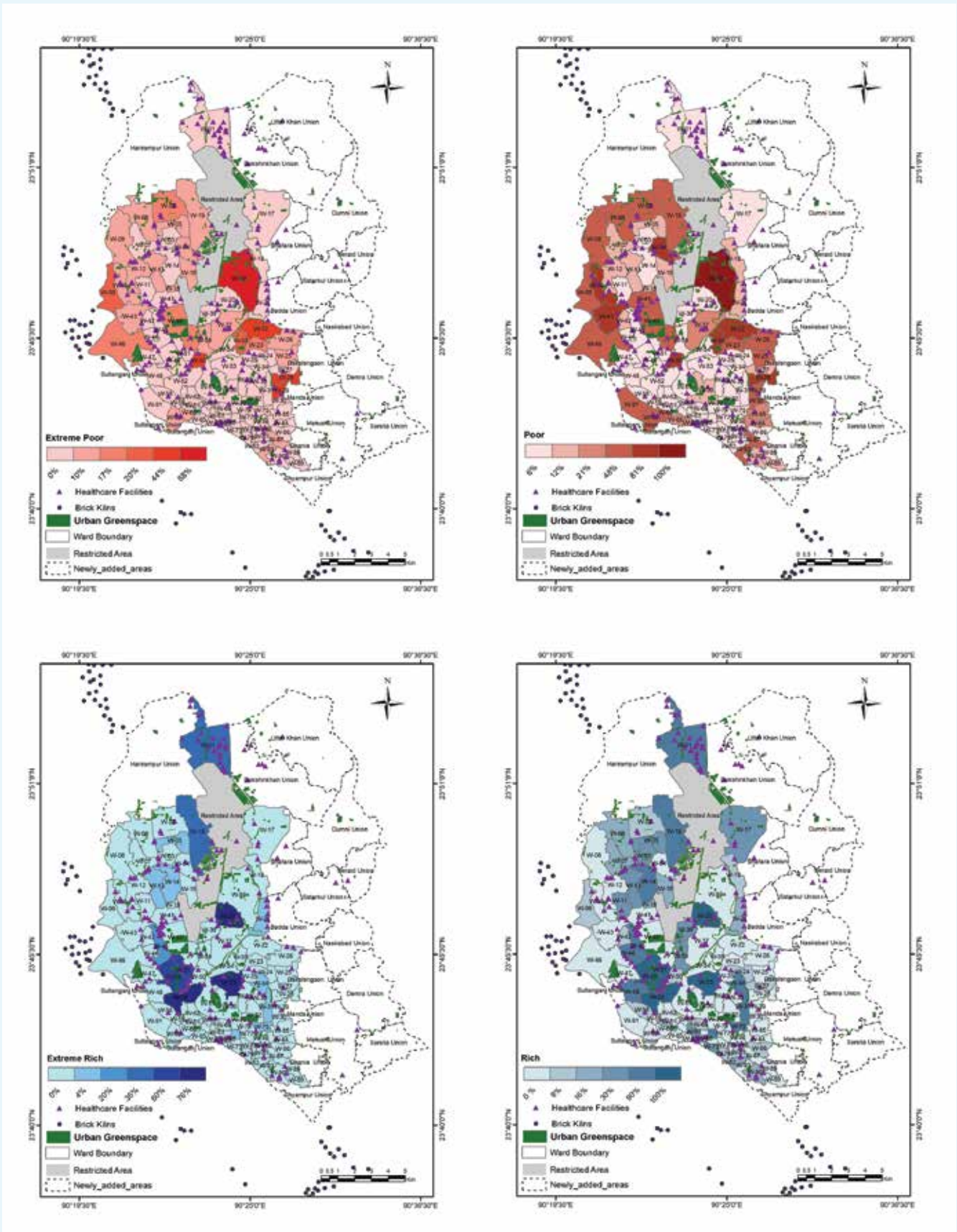


Fig. 1 Distribution of (a) extreme poor, (b) poor and (c) extreme rich, (d) rich and three quality-of-life metrics

Our study revealed that the urban poor in Dhaka have lower quality of life as they tend to live in wards with little to no access to greenspace and hospitals, and wards that are exposed to environmental pollution from brick kilns. In our analysis we have identified the greenspace zones, location of hospitals and brick kilns that are situated within or close to the city corporation area (Fig. 1). From the distribution of these features it can be observed that greenspace areas are disproportionately located in rich and extremely rich areas (Fig 1. (c, d)) as compared with poor and extremely poor areas (Fig 1. (a, b)). Ward-19, the ward with the highest levels of extreme poverty has greenspace, but only two hospitals are located in that zone. Other wards (Ward- 22, 23, 28, 46, 55 etc.) with high poverty have access to no hospitals at all. The brick kilns are situated disproportionately close to poor and extremely poor areas in Ward-08, 09, 10, 43, 46.

POLICY RECOMMENDATIONS

With growing urbanization, changing landscape, and frequent relocations of the population, such exercise are useful tool for policy formulations. To effectively tackle poverty and inequality in Dhaka, it is critical to recognize the limitations of present urban planning efforts and shift to more specialized approaches that reflect Bangladesh's social, political, and economic reality. This involves the establishment of a well-coordinated planning framework that accelerates activities while reducing division among institutions and conflict. Furthermore, community engagement is crucial assuring the active participation of local citizens, NGOs, and civil society organizations throughout the planning process, from development to implementation. Initiatives aimed at establishing inclusive and well-organized urban areas should focus on territorial division and the growth of slums, as well as pressing challenges like traffic congestion and the lack of regulation. With a focus on sustainable urban development tactics and fair distribution of opportunities and resources, Dhaka can lead the way to a more prosperous and just urban environment for all of its residents.

Policy Pathways to Daylight Availability: Addressing Challenges in Dhaka

Study Research Team: In alphabetical order

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BACKGROUND

The scarcity of available land, lack of sufficient adequate housing, poor infrastructure, and small plot sizes, have propelled densification and high-rise development, as well as encroachment of open spaces and canals. The resulting high-density urban form has produced a landscape that increases the exposure to limited daylight within residences and neighborhoods. Insufficient daylight availability poses significant challenges to the well-being and health of a city's residents. This lack of daylight varies, from floor to floor of a building, and from area to area. The quality and amount of lighting that is available in a neighborhood affects the quality of its environment and contributes to various health concerns and socio-economic disparities.

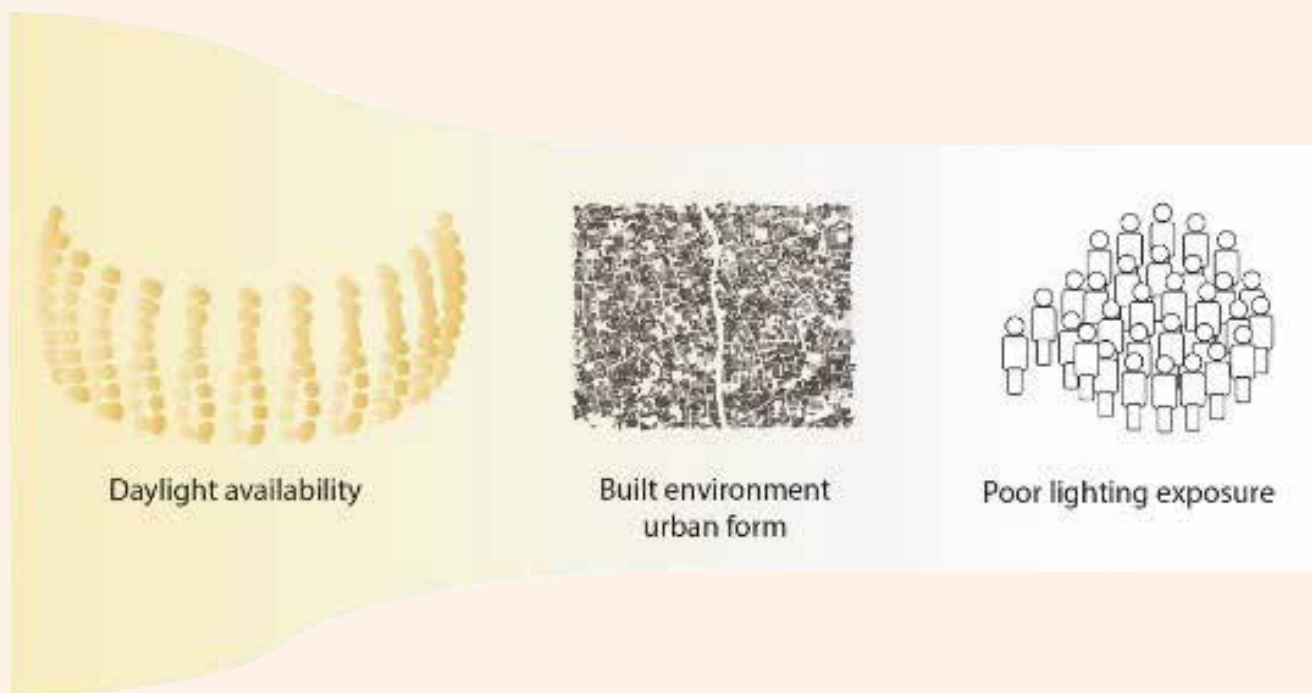


Figure 1 Conceptual diagram of daylighting exposures.

OUR STUDY

A study was conducted by BRAC James P Grant School of Public Health and Harvard University for Pathways Project, incorporating a three-dimensional daylight simulation model of Dhaka city (data source: RAJUK, 2016) and qualitative assessments in vulnerable areas. The simulation results produced hundreds of millions of observations that were hard to compare beyond the clustering of points. A hexagonal grid was introduced to produce a tessellation of points into hexagons in GIS. The basis for the hexagonal grid was, fitting the boundaries of the ward's geometries, scalability, and reducing edge effects. This study looks at the exposure to ambient daylight at the city level and aimed to understand the quality and amount of ambient lighting that is available in and within neighborhoods during daytime throughout a typical year. The simulation identified the most affected low-lighting areas in Dhaka city (wards and neighborhoods) (Figure 2 & 3).

KEY FINDINGS

Our study found significant inverse relationship between urban density and lighting levels. The low-lighting areas are also associated with certain socioeconomic status, accounting for further research in the area to identify specific health problems.

Urban Design factors and Lighting Variability

Our analysis indicates that a significant number of areas within most wards of Dhaka city experience low levels of lighting. The simulation results indicate an overall deficiency in lighting at ground level, particularly in areas with high-density urban fabric. This clustering of low lighting measurements aligns with regions characterized by dense urban infrastructure. Various factors contribute to this variability in lighting, including external elements such as buildings casting shadows, narrow streets, close proximity of buildings to each other, lack of setbacks, and tall building structures.

Our analysis indicates a correlation between higher urban densities and lower lighting levels, measured by factors such as the number of buildings per unit area and building heights. Through Principal Component Analysis (PCA), we identified building height as the primary factor influencing poor lighting conditions, accounting for 40.9% of the observed variance, followed by the number of structures in a hexagon, explaining 25.4% of the variance. This suggests that areas with greater urban density tend to receive less direct sunlight.

Regarding urban density metrics, the mean Floor-Area Ratio (FAR) per hexagon is relatively high, averaging 2.3 and ranging up to 30. Notably, the mean FAR of all vulnerable areas is 2.6, Although most hexagons fall below 1. The FAR in this analysis was dependent on acquired data, which could not always replicate the structures after being built, and sometimes showed setback areas in places where it wasn't present. So, the actual FAR in Dhaka might be higher. While FAR does not directly correlate with low lighting levels, it provides insight into the extent of urban development within specific areas.

One potential explanation for these findings is that high-density urban areas are more likely to have tall building heights, and a larger number of structures that can block natural light, leading to low ambient lighting levels, specially at the ground levels.

Socioeconomic Status

Several variables were mapped against the low-lighting areas. There is some association found between the economic activities of a household and the location of slum areas (slum census 2010) with low lighting levels. This calls for more granular data on certain socioeconomic aspects of the population and citywide coverage of the datasets to analyze more about the associated socioeconomic factors.

Health Concerns and livelihood challenges

The results of this study suggest that a significant relationship between urban density and lighting levels exists which potentially could affect the health of Dhaka city residents. The lack of natural light could have negative impacts on residents' health, including disrupting circadian rhythms and increasing the risk of depression and other mood disorders, along with vitamin D deficiency (3,4,5).

Alongside health concerns, residents of these areas with poor ambient lighting face various challenges including safety and security both inside and outside their homes, as well as interruptions to household tasks. Children struggle to read, elderly individuals are prone to falls, and household chores, particularly cutting and cooking, are hampered by poor lighting.

WAY FORWARD

The results of this study have important implications for urban planning and public health policy. By identifying areas of the city with inadequate lighting and high-density metrics, policymakers can target interventions to improve lighting and promote healthier urban environments. The first step to solve the problem of insufficient daylight in households is to address it in the policies. Urban planning and design guidelines should incorporate maximizing daylight exposure in building design. Besides, urban green spaces, walkability, and availability of essential facilities within walking distance should be considered in planning any neighborhood, as these are interconnected to solve lighting problems in the city.

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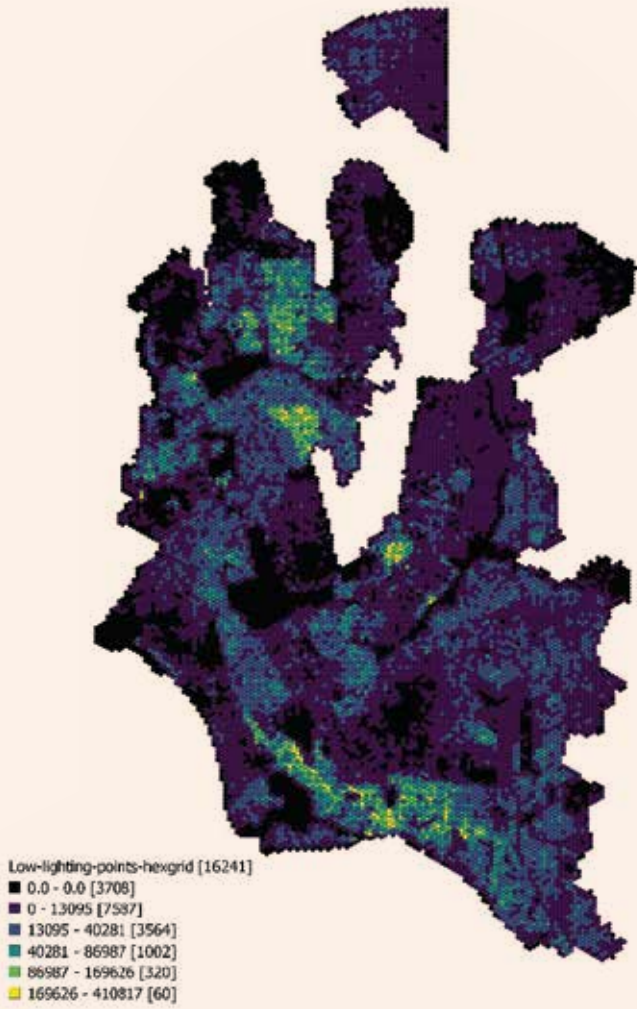


Figure 3 Heatmap of low-lighting measurements (Yellow represents the highest density of low-lighting grids)

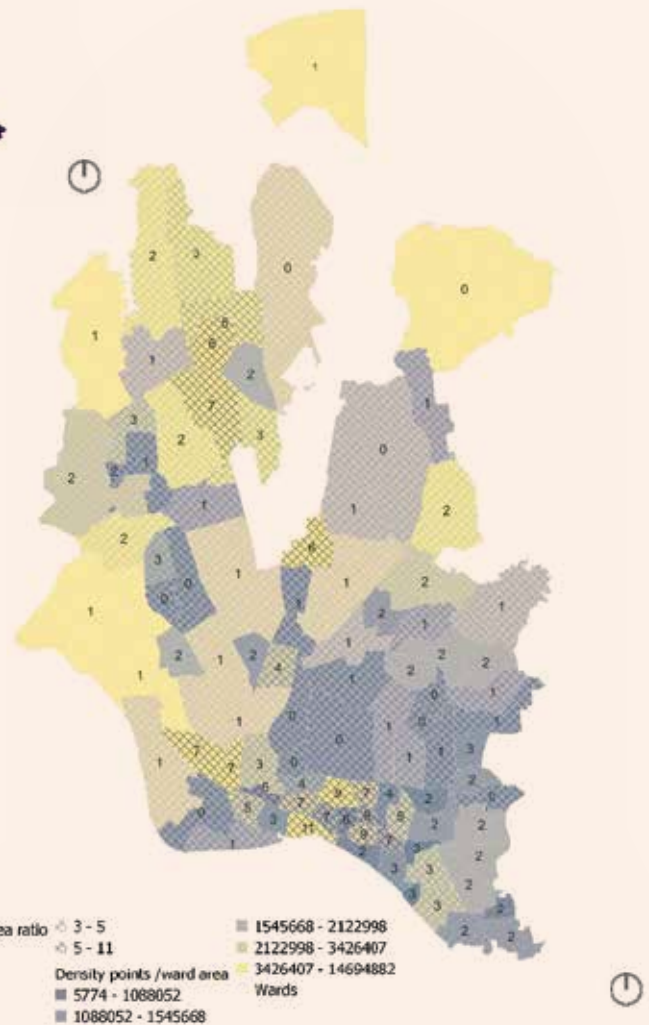


Figure 2 Map of low lighting density area ratio by wards.

Is Air Quality Equally Poor Across the Dhaka City? An Attempt to Improve Our Current Understanding of Air Pollution!

Study Research Team: In alphabetical order

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BACKGROUND

The air quality in Dhaka has significantly deteriorated in recent years and has become a serious public health concern. Air pollution aggravates cardiovascular and respiratory illnesses, and existing levels are likely to contribute to the high annual deaths in Bangladesh. More middle-aged people are suffering from respiratory diseases, and hospitals are treating more patients with Asthma and COPD, exacerbated by exposure to air pollution. Although the health and economic burden is increasing because of air pollution, there is a lack of research on that topic.

The available air quality data from only three continuous air monitoring stations (operated by the Department of Environment) is inadequate for any evidence-based study regarding public health outcomes.

KNOWLEDGE GAPS

Significant knowledge gaps exist on air monitoring networks due to limited low-cost optical sensors, which lack coverage in key suburban areas, slums, and industrial areas. Also, there are insufficient information about regional versus local source contributors to air pollution.

POLICY AND IMPLEMENTATION GAPS

There are several key issues contributing to air pollution in the city. Firstly, there is a policy gap regarding the categorization of industries, leading to inconsistencies in regulating their pollution levels. Construction sites are a significant source of pollution, but policies governing them are not consistently enforced. Additionally, there is a lack of effective policies concerning emissions from cars and motorbikes, as many do not adhere to established standards. Furthermore, mixed modes of vehicles on the road increase traffic congestion and eventually air pollution. Proper monitoring of pollution levels is hampered by inadequate instruments and a lack of skilled personnel.

OUR STUDY

Researchers at BRAC JPGSPH collaborated with Imperial College London and McGill University to conduct a city-wide measurement campaign of PM_{2.5} and black carbon, aiming to investigate source contributors to air pollution and produce a high-resolution spatial model to estimate air pollution across the city. Two seasonal (two months each) air monitoring campaigns have recently been conducted (2023) from eight fixed sites (2 months) and sixty-one rotating sites (3 days), considering the major land use classes across the city domain.

BRAC JPGSPH also conducted KIIs and FGDs in several vulnerable communities to understand air pollution perceptions and get recommendations regarding individual, community-level, and national-level approaches.

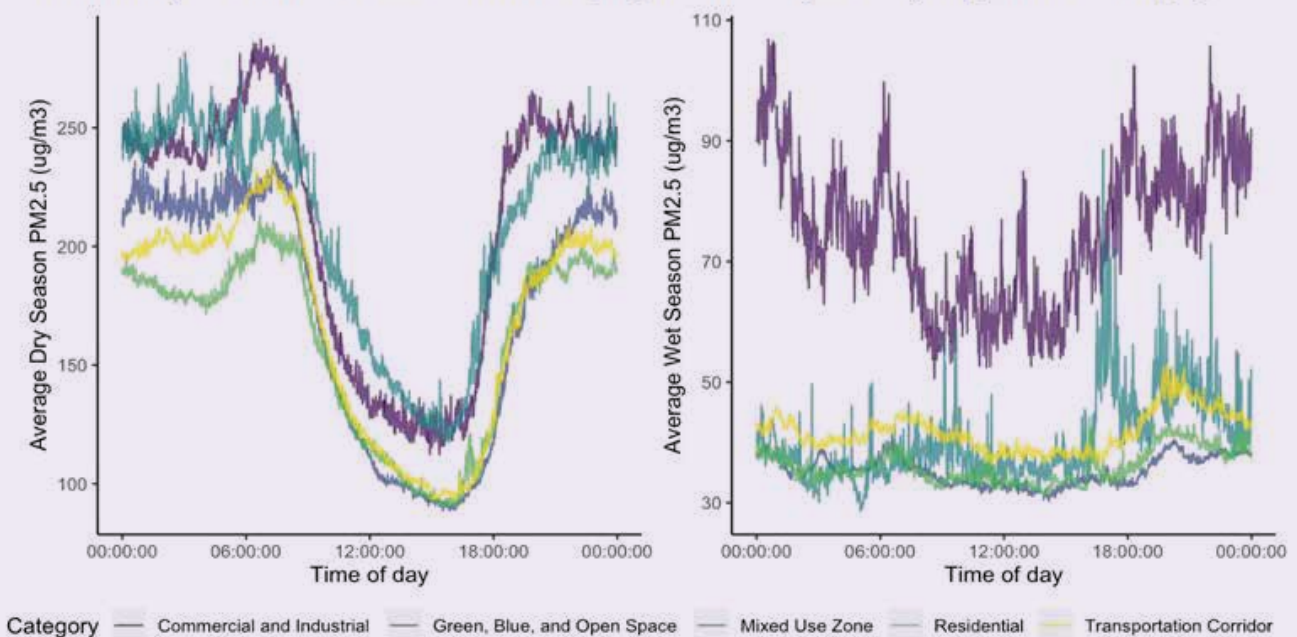
Besides, a knowledge co-production workshop was conducted in September 2022 among the key stakeholders to address the emerging issues around air pollution, current policy debates, identification of policy gaps, and potential solutions.

KEY FINDINGS

Preliminary results showed that PM_{2.5} levels were substantially higher (often exceeded the WHO 24-hour standard, 15 µg/m³) in the dry season compared to the wet season across all sites. Concentrations were also higher during nighttime compared with daytime in both seasons, though the difference was more pronounced in the dry season. Commercial and industrial sites had the highest PM_{2.5}. The fixed site in a major industrial area, Shyampur, showed the highest concentrations compared to the other sites during both seasons, with a dry season average of 290 µg/m³ and a wet season average of 175 µg/m³.

The real-time PM_{2.5} data will be further compared with the filter-based gravimetric measurements for quality assurance. Filters are currently being analyzed for mass, black carbon, and chemical composition in a geochemistry laboratory to aid identification of pollution sources across the city.

Preliminary results of PM_{2.5} diurnal graphs side by side (subject to change)



Note: Averaged all PM_{2.5} readings at a given time of day for entire season

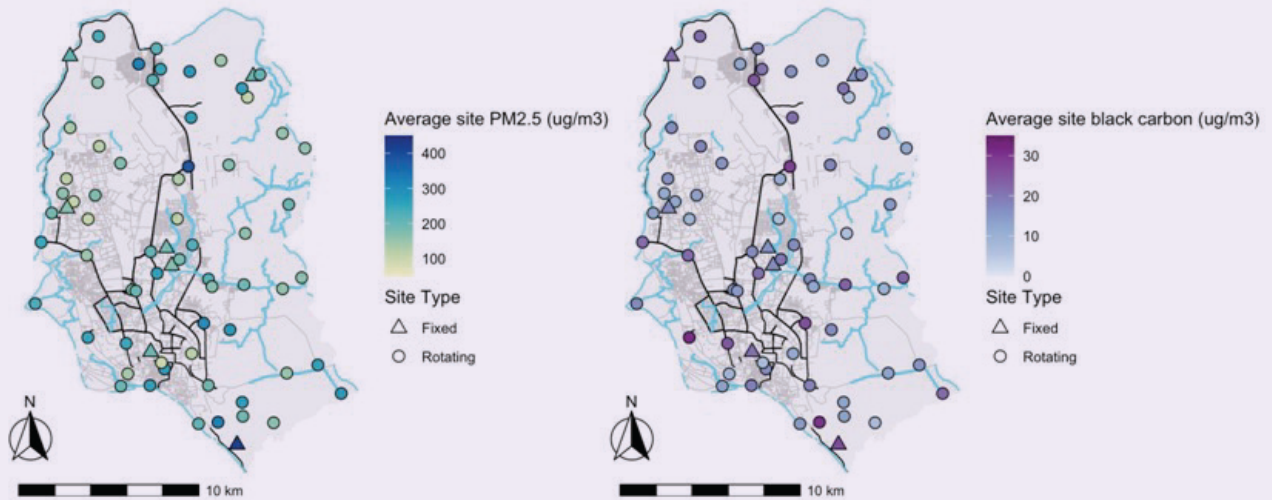
POSSIBLE SOLUTIONS TO REDUCE AIR POLLUTION

Multiple strategies have been proposed to address air pollution in and around Dhaka city. Firstly, there needs to be a focus on identifying pollution sources to target mitigation efforts effectively. This includes implementing measures to control emissions from industrial and commercial sites. In industries such as brick manufacturing, transitioning from traditional bricks to more environmentally friendly building blocks is recommended. Additionally, integrating green technology, currently lacking in many industries, can significantly reduce pollution levels.

To address vehicle emissions, there should be limitations on the number of vehicles allowed on the roads, along with separate lanes designated for fast and slow-moving traffic. Policies promoting the use of public transport, bicycles, and the development of walkable footpaths are crucial for reducing reliance on private cars.

Enforcing penalties for environmental violations is essential to encourage compliance with regulations. Creating open spaces and water bodies can also help mitigate pollution by providing natural areas for air and water purification.

Air maps (dry season only)



- PM2.5 data is UPAS filter-based; for fixed sites, the average of all filters was used.
- Black carbon data is based on corrected BC filter data; for fixed sites, the average of all filters was used.
- All data is from the winter season only

Note: The results are provisional and subject to change with temporal alignment

A robust government body tasked with monitoring pollution sources must be well-equipped for effective oversight. Furthermore, as seen in successful models like the UK, harnessing the energy of youth and student-based activism can be instrumental in driving meaningful change. Finally, raising awareness and fostering self-motivation among the public are vital components of any comprehensive pollution mitigation strategy.

FUTURE RESEARCH DIRECTION

The findings of the air monitoring study will be conducive to assessing public health outcomes by incorporating socio-demographic and health data with the air quality data from this study, which is much needed in formulating improved Environmental and Public health policies.

Are we addressing the issues of Noise Pollution in Dhaka City? An attempt to minimize our current knowledge gaps!

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BACKGROUND

Dhaka has the highest noise pollution among the sixty-one most populated cities worldwide (Prothom Alo, 2023). 'Frontiers 2022: Noise, Blazes and Mismatches' by the United Nations Environment Programme, Dhaka tops the list, while India's Moradabad of Uttar Pradesh and Islamabad of Pakistan occupy the second and third positions in noise pollution, respectively. Exposure to noise can lead to annoyance, stress, anxiety attacks, tinnitus, and sleep disturbance, and prolonged exposure can increase the risk of cardiovascular diseases and cognitive impairment in adults and children. Although the health and economic burden is increasing because of prolonged exposure to noise pollution, there is a lack of research on that topic. Many people in Bangladesh don't even know there is a law that makes noise pollution an offense.

KNOWLEDGE GAPS

Significant knowledge gaps exist due to a lack of routine monitoring of sound levels, especially in key urban areas and neighborhoods, considering major land use characteristics. There is limited information available about sources contributors to noise pollution and their spatiotemporal variabilities. While noise pollution is reported anecdotally as very high, research in this area is primarily limited to qualitative studies.

POLICY AND IMPLEMENTATION GAPS

An implementation gap exists in adhering to noise laws. Excessive use of hydraulic horns and lack of monitoring to detect sound levels on the road worsens the issue. Additionally, deficiencies in urban design and planning, particularly the presence of high-rise buildings that create echoes, contribute to noise pollution. Furthermore, the lack of environment-friendly spaces, such as green spaces, and insufficient promotion and advertisement regarding laws related to noise pollution also aggravate the problem.

OUR STUDY

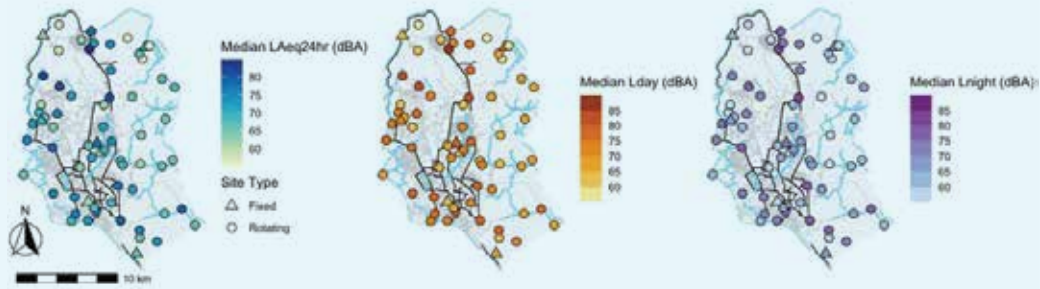
Researchers at BRAC JGSPH collaborated with Imperial College London and McGill University to conduct a city-wide noise monitoring campaign to investigate source contributors to sound pollution and produce a high-resolution spatial model to estimate pollution levels across the city. Two seasonal (two months each) noise monitoring campaigns have recently been conducted (2023) from eight fixed sites (2 months) and sixty-one rotating sites (3 days) considering five major land use classes (Commercial and industrial; Green, blue, and open spaces; Residential; Transportation corridor; and Mixes use zone) across the city domain.

A knowledge co-production workshop was conducted in September 2022 among the key stakeholders to address the emerging issues around noise pollution, current policy debates, identification of policy gaps, and potential solutions.

KEY FINDINGS

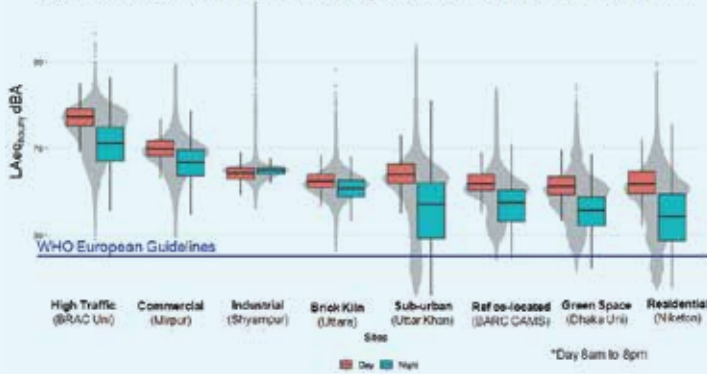
Preliminary results showed that the noise level exceeded national standards (residential 45 to 55 dB), WHO (road traffic 45 to 53 dB), and European Guidelines (55 dB) at almost every site in five major land use classes considered for this study. The median 24-hour noise level (dB) and its diurnal variability were more or less similar during the dry and wet seasons. The noise levels were generally substantially higher during the daytime than at nighttime in both seasons. Usually, the highest noise levels were associated with office closing hours at around 6 pm. The mixed-use zones and high-traffic areas typically showed the highest noise level compared to the other sites during both seasons, with a wet season average peak of approximately 75-85 LAeqhourly dBA. This may adversely affect people spending most of their time in these outdoor environments.

Noise maps showing preliminary results: median LAeq24hr per site

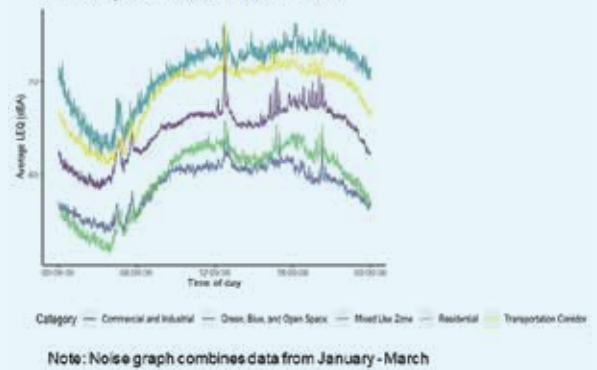


- Includes noise data from January - March
- Daytime was defined as 6 am - 8:59 pm. Nighttime was defined as 9 pm - 5:59 am.

Dry season: distributions of LAeqhourly dBA across 8 fixed sites in Dhaka



Diurnal patterns of Noise Level



Note: Noise graph combines data from January - March

POSSIBLE SOLUTIONS TO REDUCE NOISE POLLUTION

A robust government body for monitoring pollution is essential, equipped to oversee various pollution sources effectively. There should be a focus on managing sources of noise pollution, including measures to control the number of vehicles on the streets and reduce the use of hydraulic horns. Strict enforcement of laws and penalties is crucial in this regard.

Policies promoting car control, encouraging the use of public transport and bicycles, and the development of walkable footpaths are necessary. Implementing noise barriers and traffic management solutions such as traffic lights or stop signs can help reduce the need for honking.

Strong regulations must be in place to safeguard existing open spaces and water bodies from being filled up or encroached upon by developers. Additionally, raising awareness and fostering self-motivation among the public are key components of addressing pollution effectively.

FUTURE RESEARCH DIRECTION

The findings of the noise monitoring study will be conducive to assessing public health outcomes by incorporating socio-demographic and health data with the noise quality data from this study, which is much needed in formulating improved Environmental and Public health policies.

Healthy Dhaka: Way forward for a bicycle friendly city

Study Research Team: In alphabetical order

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BACKGROUND

Dhaka, one of the most densely populated megacities in the world, is expanding in all directions, presenting multifaceted challenges. The increasing population of more than 20 million people in an area of about 306 square kilometers has huge burden on its housing, transportation, and environment, among others. All of these ultimately affect the health of the people living in the city. While in 2018, the obesity rate was 30.8% in Dhaka division, highest in the country, it was 31.9% in 2022 (1). This calls for a solution that is sustainable, low-cost, and is doable in the context of Dhaka.

Here comes bicycling, which doesn't require a lot of space, new roads or infrastructures, is environment friendly, and has potential health benefits. In a survey conducted in 1996, almost 2% of the people in the city rode bicycles. In the present context, students, low-income people, and health-conscious people are the main users of bicycles in Dhaka.

OUR STUDY

The BRAC James P Grant School of Public Health, BRAC University has undertaken research with the aim of transforming Dhaka into an equitable and healthy city. This initiative is part of the "Pathways to Equitable Healthy Cities" project, funded by the Wellcome Trust. Within the scope of this project, transportation has been identified as a focal point. A study titled "Bicycle Use, Access, and Barriers in Dhaka" was carried out under this thematic domain. This comprehensive investigation employed a mixed-method approach, encompassing a questionnaire survey, key informant interviews, in-depth interviews, and an ethnographic observation survey.

KEY FINDINGS

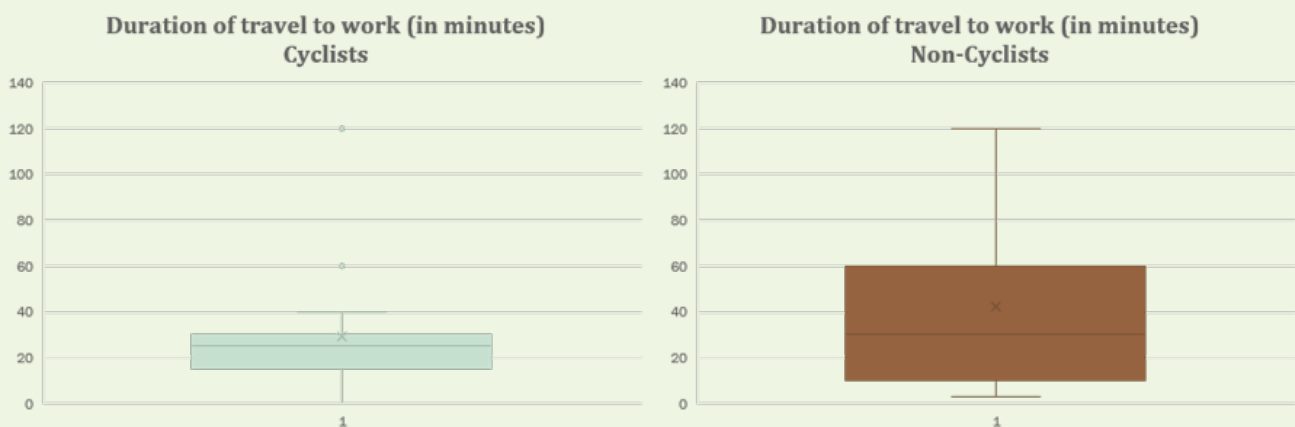
Health Perspective

Bicycling offers various health benefits. The need for bicycling in Dhaka is not only as a means of transportation but also as a form of exercise. The research indicates that individuals, whether active cyclists or not, are aware of the health advantages associated with cycling. To elaborate:

- The people of Dhaka are experiencing a rise in obesity, and bicycling holds the potential to mitigate this trend.
- Bicycling serves as a means of exercise and cardiovascular activity.
- Cycling contributes to the enhancement of overall lower body function and the strengthening of leg muscles.

Economic Perspective

Bicycling proves to be economically feasible for a diverse range of individuals. With the starting price of new bicycles at 4000 BDT (2023), their cost-effectiveness becomes apparent over their lifespan. Additionally, from a policy standpoint, promoting and facilitating bicycle usage emerges as a budget-friendly solution. Cycling is mainly used for short trips, the average duration of a cyclist's trip to work in Dhaka falls within the range of 15-30 minutes, and generally, people cover these short distances through buses, rickshaws, or CNG autorickshaws. Cycling can be a better alternative in this perspective, saving time and money. Consequently, the development of bicycle lanes should consider people's perception of where and how far they can commute with bicycles. This can also reduce traffic jams in the busy business districts and market areas, saving more in work time.



Environmental Perspective

Bicycles are recognized as environmentally friendly vehicles. From production to use, bicycle pollutes the environment the least, and recycling or disposal is comparatively more systematic in the Dhaka context. Cycling bypasses the use of fossil fuels, which is one of the major sources of air pollution in cities. In the European Union, cycling saves more than 16 million tons of CO₂ equivalents per year (2).

- One of Dhaka's major air and noise pollution sources is transportation. Bicycles don't emit any gases and don't contribute to the air pollution
- Bicycles generally don't contribute to noise pollution
- Cycling reduces Carbon footprint

Cycling Habit

Our observation found a significant number of children cycling in all the sampling locations of Dhaka. Whether it rains or scorching heat, children play with bicycles in the streets and at the roadside empty spaces. These roadside empty areas and fields play a crucial role in the process of learning to ride bicycles, as indicated by respondents who acquired this skill in villages (53%) or within the fields of Dhaka city (39%). Unfortunately, many of these spaces in Dhaka have undergone transformation, leading to a scarcity of areas for children or individuals to acquire bicycle-riding skills.

Several factors act as deterrents to cycling, including increased distances from home to schools or workplaces, inadequate cycle parking spaces, the absence of dedicated lanes, a lack of open spaces and playgrounds, societal stigma, and rising bicycle prices. Despite the generally positive and encouraging perception of cycling in Dhaka, parents tend to restrict their children from cycling for safety issues and lack of safe spaces.



WAY FORWARD

Based on the findings from our study, we want to address some challenges and opportunities that have the potential to increase bicycling in Dhaka.

- Creating bicycle lanes with a sustainable and feasible objective (a complete route from residential to business districts, educational institutions, markets, MRT stations, and Bus stands)
- Integrating cycling with BRT and Metro Rail system
- Collaborating with bicycle-related investments and ideas to promote sustainable and eco-friendly transportation
- Keeping bicycles as a means of transportation in designing new cities/projects
- Need more detailed discussions about bicycling in transport-related policies
- Reducing VAT and TAX from bicycle manufacturing and sales services
- Need to create secure bicycle parking spaces at business districts, markets, govt. and non-govt. offices, and in educational institutions
- Promoting Cycling as a sport, with dedicated cycling tracks near the cities

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Transportation Accessibility and Safety in Dhaka City: A Gender Based Assessment

Study Research Team: In alphabetical order
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BACKGROUND

The accessibility and safety of passengers on roads and within the public transportation system in Dhaka city have received significant scrutiny in recent years. Specifically, during rush hours, public buses in Dhaka city become exceedingly crowded, posing challenges for passengers to access them safely. While incidents of sexual harassment targeting female passengers in public buses in Dhaka city receive more attention, general forms of harassment including snatching, passenger disputes, staff quarrels or physical conflicts, premature ejection of passengers before reaching their destinations, and reluctance to pick up passengers during peak hours are more prevalent issues observed in Dhaka city. The study computed the differences in daily trip frequency by modes and by purpose for men and women; analyze the differences in transportation accessibility and harassment faced (e.g., sexual versus general) by the commuters of Dhaka city; and compared the differences in 'level of satisfaction' of commuting in public buses versus metro rail by gender.

OUR STUDY

The study conducted by BRAC James P Grant School of Public Health uses quantitative analysis to assess gender-specific differences in transportation accessibility and safety in Dhaka. The study focuses on commuting patterns and experiences in Dhaka city, targeting working-class individuals and university students over 18 years old. A total of 1030 respondents were surveyed, with 52% from hostels/apartments, 10% from slum areas, and 38% from other locations. Among the respondents, 60% are female and 40% are male; while 20% are students and 80% are working- individuals. Three additional modules of data collection were also used: (i) enumerators kept a 14-day travel diary; (ii) two pairs of enumerators recorded trip itineraries using GPS for ten selected routes; and (iii) a brief questionnaire with 1,513 passengers was completed at 14 metro rail stations.

RESULTS

The analysis reveals that distance significantly influences job acceptance and rejection, with differences between genders. While 26% of male workers cited distance as a factor in rejecting job offers or leaving positions, the figure rose to 37% among females. Similarly, 55% of females cited distance as a key factor in job acceptance, compared to 37% of males. Moreover, 43% of female respondents mentioned relocating for easier commuting, significantly more than the 32% of males.

Analyzing yesterday's commuting data, it's evident that 77.1% of females in Dhaka use public buses combined with rickshaws/another motorized vehicle, compared to 63.2% of males. Both male and female commuters in the city

make more than two trips daily, with no statistical difference in trip frequency among students (males: 2.37, females: 2.26). However, among working individuals, males take significantly more trips (2.62) compared to females (2.14). Furthermore, a higher percentage of working males (19.5%) traveling longer distances to reach their workplaces compared to females (12.5%).

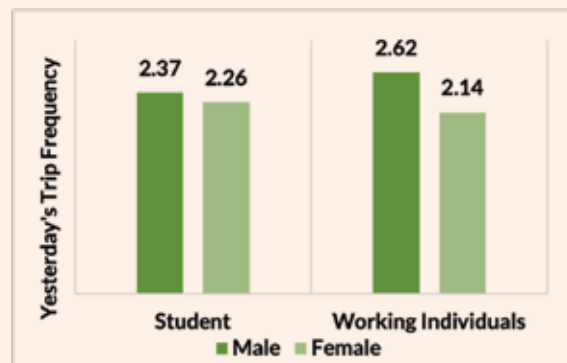


Figure 1: Yesterday's Average Trips using Public Transportation by Gender

On average, a 20-kilometer journey by public bus in Dhaka city takes slightly over 2 hours, maintaining an average speed of 9.8 km/h. Nevertheless, traffic movement in Dhaka city varies throughout the day, with morning traffic moving faster at 11.9 km/h, noon traffic slowing to 7.9 km/h, and evening traffic maintaining a speed of 9.2 km/h. Analysis of data further suggest commuters of public buses experience an average waiting time of 12.46 minutes per trip. Moreover, only 27.5% of male students and 15.4% of female students managed to ride a public bus without missing one, with males students missing 2.43 buses and female students missing 2.68 buses on average before boarding. Similarly, female working individuals miss nearly 2.57 public buses, while males miss 2.52 buses before boarding during rush hours.



Figure 2: % of Commuters Faced Sexual Harassments

The analysis on harassment in public buses are analyzed in three distinct phases (ever in life, yesterday and last trip) to gauge its severity. Sexual harassment (e.g., unwanted touch on body, inappropriate staring and comments etc.) is more common among females while male commuters suffer more from general harassment (snatching, quarrels/fight etc.) in public transports in Dhaka city. About 79% of female commuters have face sexual harassment in public transportation. Furthermore, 16% female commuters face sexual harassment per day while 9% of them faced it in the last trip they made prior participating in the survey.

The introduction of the Dhaka Metro rail has prompted a shift among 35% of commuters, including 40% of males and 31% of females, away from public buses, with an additional 11% of female rickshaw users transitioning, highlighting a notable change in commuting habits. Operating between Motijheel and Uttara North, covering a

distance of 20.7 km in 35 minutes, the metro achieves an average speed of 35.7 km/h, resulting in significant time savings for users, with 40% reporting savings of 10 to 30 minutes, 35% saving between thirty and sixty minutes, and 7% saving over an hour per trip, showcasing its efficacy in alleviating traffic congestion.

Dissatisfaction with the existing public bus services is found widespread, with most respondents expressing low levels of satisfaction, scoring below 0.5 regardless of gender. However, with the advent of the metro rail, a significant shift occurred, with commuters expressing notably higher levels of satisfaction, most of them reporting scores exceeding 0.5. The notable shift of right to left 'skewness' in the level of satisfaction highlighted the transformative impact of the metro rail, providing commuters with a reliable and efficient alternative for their daily journeys.



Figure 3: Metro Rail Statistics

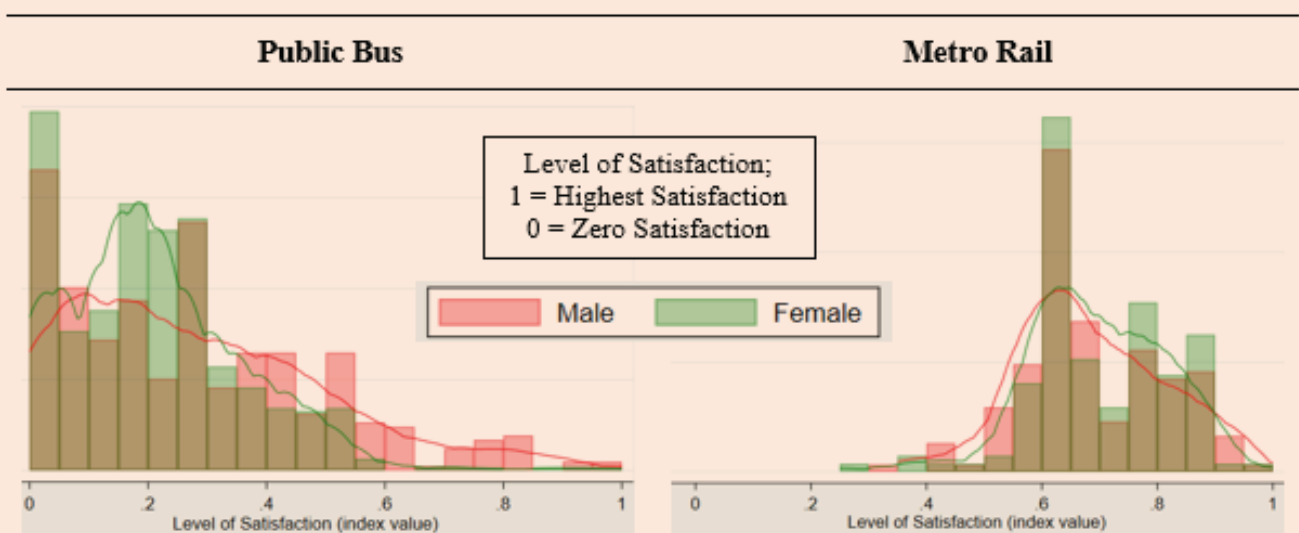


Figure 4: Level of Satisfaction of Commuting by Modes of Transportation and by Gender

POLICY RECOMMENDATIONS

Given the empirical evidence highlighting enhanced satisfaction, decreased commute times, and lowered harassment incidents consequent to the new metro rail system, there is a clear imperative to expedite the completion of the remaining five metro lines by 2030.

In addition, 'a digital diary' can be introduced in educational and professional settings (workplaces) to allow commuters to record their firsthand experiences in public transportation, encompassing both positive and negative occurrences. The Ministry of Social Welfare, the Ministry of Women and Children Affairs, and the Dhaka Metropolitan Police should jointly coordinate among themselves to establish it as a standardized incident reporting mechanism. This collaborative endeavor should strategically target the reduction of sexual and general harassment incidents within Dhaka's public transportation network, facilitating efficient incident reporting and resolution mechanisms. As addressing harassment in public transportation is a multifaceted issue intertwined with educational quality, awareness campaigns, and infrastructure improvements, this data-driven approach can accelerate the reduction of daily harassment incidents, ultimately benefiting the mental well-being and productivity of commuters in Dhaka.

The study indicates that nearly 79% of female commuters in Dhaka have experienced sexual harassment on public transport, with about 60% feeling traumatized and 12% unable to overcome the experience. This highlights the significant negative impact of such incidents on mental health. While knowing the overall lifetime harassment rate is insufficient for devising solutions, the study's analysis reveals that one in every six female commuters faces daily sexual harassment. Therefore, regularly updating the daily harassment rate using an incident reporting framework mentioned above is crucial for targeted action.

PUBLICATIONS FROM THE PROJECT

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PEER REVIEWED JOURNAL ARTICLES

1. An overview of progress towards implementation of Solid Waste Management policies in Dhaka, Bangladesh
Author: Delufa Tuz Jerin, Hasna Hena Sara, Marzuka Ahmad Radia, Prianka Sultana Hema, Shahriar Hasan, Salma Akter Urme, Camilla Audia, Md Tanvir Hasan, Zahidul Quayyum
Journal: Heliyon
Date of Publication: Feb 22, 2022
2. Synthesizing the links between secure housing tenure and health for more equitable cities
Author: Jill Baumgartner, Judith Rodriguez, Frans Berkhout, Yvonne Doyle, Majid Ezzati, George Owusu, Zahidul Quayyum, Bethlehem Solomon, Meghan Winters, Gary Adamkiewicz, Brian E. Robinson
Journal: Wellcome Open Research 2022
Date of Publication: Jan 2022
3. Dhaka landfill waste practices: addressing urban pollution and health hazards.
Author: Urme SA, Radia MA, Alam R, Chowdhury MU, Hasan S, Ahmed S, Sara HH, Islam MS, Jerin DT, Hema PS, Rahman M.
Journal: Buildings & cities
Date of Publication: July 2021
4. Dhaka city water logging hazards: area identification and vulnerability assessment through GIS-remote sensing techniques
Author: Rafiul Alam, Zahidul Quayyum, Simon Moulds, Marzuka Ahmad Radia, Hasna Hena Sara, Md Tanvir Hasan & Adrian Butler.
Journal: Environmental Monitoring and Assessment
Date of Publication: April 2023
5. Loops and Building Blocks: a Knowledge co-Production Framework for Equitable Urban Health
Author: Camilla Audia, Frans Berkhout, George Owusu, Zahidul Quayyum, Samuel Agyei-Mensah
Journal: The Journal of Urban Health
Date of Publication: June 2021
6. A quantitative assessment of natural and anthropogenic effects on the occurrence of high air pollution loading in Dhaka and neighboring cities and health consequences
Author: Riaz Hossain Khan, Zahidul Quayyum & Shahanaj Rahman
Journal: Environmental Monitoring and Assessment
Date of Publication: November 2023

BOOK CHAPTER

1. Spatiotemporal Variability of Urban Greenspace and Surface Temperature in Dhaka City: A Public Health Aspect
Author: Khadiza Tul Kobra Nahin, Hasna Hena Sara, Krishna Rani Barai, Zahidul Quayyum, and Jill Baumgartner
Name of Book: The Empathic City: An Urban Health and Wellbeing Perspective
Publisher: Springer
Date of Publication: July 2023

NEWSPAPER ARTICLES

1. Effective solid waste management can alleviate the severity of the waterlogging situation in Dhaka (Blog)
Author: Rafiul Alam and Hasna Hena Sara
Newspaper: Dhaka Tribune
Date of Publication: October 2021
2. Taking the bus as a girl in Dhaka: A view of Dhaka city's broken commuting system (Blog) Author: Sabrina Mustabin Jaigirdar, Zahidul Quayyum
Newspaper: Dhaka Tribune
Date of Publication: June 7, 2022
3. Prothom Alo featured the school campaign of Public Engagement on Waste Management and Waterlogging in Dhaka City.
Title: "১০০ জনের স্কুলে বর্জ্য পরিষ্কারের কার্যক্রম" (100 people's school waste management program)
Newspaper: Prothom Alo
Date of Publication: March 22, 2023

BLOGS

1. Why cities need to preserve green space: A case study of Dhaka city (Blog)
Author: Khadiza Tul Kobra Nahin, Hasna Hena Sara, Dr Zahidul Quayyum Website for Blogs: Pathways to Equitable Healthy Cities BLOG.
Date of Publication: Jan 2022
2. A Knowledge Coproduction Workshop for an Equitable Healthy Dhaka City Author: Sabrina Mustabin Jaigirdar, Zahidul Quayyum
Website for Blogs: BRAC University
Date of Publication: October 16, 2022
3. The complexities of the urban development: An insight into the policy dimensions Authors: Sabrina Mustabin Jaigirdar, Zahidul Quayyum
Website: Pathways to Equitable Healthy Cities
Date of Publication: Nov 29, 2022
4. **Celebrating Student Initiatives:** Certificate Giving Ceremony for Waste Management Champions
Author: Sabrina Mustabin Jaigirdar, Zahidul Quayyum
Website: Pathways to Equitable Healthy Cities
Date of Publication: JANUARY 23, 2024



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