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State of Dhaka Environment

An Analysis of Water, Air, and Noise Pollution in Dhaka

" Promoting democratic governance and collective advocacy for environmental protection in Dhaka City
under
Promoting Advocacy and Rights (PAR) Activity"

2021-2022

Center for Atmospheric Pollution Studies (CAPS)
Department of Environmental Science
Stamford University Bangladesh

WATERKEEPERS BANGLADESH

Department of Geography and Environment
ভূগোল ও পরিবেশ বিভাগ
Jahangirnagar University
জাহাঙ্গীরনগর বিশ্ববিদ্যালয়

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Authors:

Md. Nurul Islam, PhD
Professor, Department of Geography and Environment, Jahangirnagar University
General Secretary, Bangladesh National Geographic Association (BNGA)

Dr. Ahmad Kamruzzaman Majumder
Professor, Department of Environmental Science, Stamford University Bangladesh
Chairman, Center for Atmospheric Pollution Studies (CAPS)

Sharif Jamil
Coordinator, Waterkeepers Bangladesh
Member Secretary, Dhoritri Rokhhay Amra (DHORA)

Contributors
S M Gubair Bin Arafat
Mohammad Golam Sarwar
Dr. Syeda Nasrin
Syed Taposh
Md. Sayeed Hossain
Anika Tahsin
Md. Nasir Ahmed Patoary
Sakib Rahman Siddique Shuvo
Mahamudul Hasan

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Table of Contents

Table of Contents....iii
List of Tables....vii
List of Figures....viii
Acronyms and Abbreviations....xii
Foreword....xiv
Acknowledgement....xv
Executive Summary....xvi
CHAPTER ONE: INTRODUCTION....1
1.1 Water Pollution....1
1.2 Air Pollution....2
1.3 Noise Pollution....3
1.4 Role of Civil Society and Communities in Pollution Advocacy....3
1.5 Aim and Objectives of the Study....4
1.6 Research Design....5
1.7 Organisation of the Report....5
CHAPTER TWO: DATA AND METHODS....7
2.1 Rivers of Dhaka....7
2.2 Sampling....8
2.2.1 Water Quality Analysis....8
2.2.2 Air and Noise Quality Analysis....10
2.2.3 Community Perception Analysis....12
2.2.4 Policy and Legislative Framework Analysis....12
2.3 Data Collection....13
2.3.1 Water Quality Data....14
2.3.2 Air Quality Data....15
2.3.3 Noise Level Data....17
2.3.4 Civil Society and Community Perception Data....18
2.3.5 Policy and Legislative Framework Data....18
2.4 Data Analysis....18
2.4.1 Water Quality Data....18
2.4.1.1 Conceptual Framework of CCME WQI....18
2.4.1.2 Formula and Step for calculating CCME WQI:....19
2.4.2 Air Quality Data....20
2.4.3 Noise Quality Data....21
2.4.4 Civil Society and Community Perception Data....22
2.4.5 Policy and Legislative Data....22

CHAPTER THREE: WATER, AIR AND NOISE QUALITY OF DHAKA....23
3.1 State of Water Quality....23
3.1.1 Spatial and Temporal Dynamics of the PH of 2021....24
3.1.2 Spatial and Temporal Dynamics of the TSS in 2021....24
3.1.3 Spatial and Temporal Dynamics of the Oxygen Level in 2021....25
3.1.4 Chemical Oxygen Demands (COD) Levels....26
3.1.5 Biological Oxygen Demand (BOD) Levels....26
3.1.6 Spatial and Temporal Dynamics of the Ammonia in 2021....27
3.1.7 Spatial and Temporal Dynamics of the Oil and Grease in 2021....28
3.1.8 Spatial and Temporal Dynamics of the Sulphides in 2021....29
3.1.9 Spatial and Temporal Dynamics of the Phenols in 2021....30
3.1.10 Spatial and Temporal Dynamics of the Cadmium in 2021....31
3.1.11 Seasonal Comparative Analysis of Water Pollution of 2021 and 2022....31
3.1.12 Pre-Monsoon of 2021 and 2022....31
3.1.13 Level of pH....32
3.1.14 Level of Total Suspended Solids (TSS)....33
3.1.15 Level of COD....34
3.1.16 Level of BOD....34
3.1.17 Level of Ammonia....35
3.1.18 Level of Oil and Grease....35
3.1.19 Level of Sulphides....36
3.1.20 Level of Phenol....36
3.1.21 Level of Cadmium....37
3.1.22 Monsoon of 2021 and 2022....38
3.1.23 Post-Monsoon of 2021 and 2022....41
3.1.24 Pre-Season of 2021 and 2022....42
3.1.25 Comparison of Findings with DoE Data....44
3.1.26 Water Quality Assessment....46
3.1.27 Water Quality Index of Pre-Monsoon and Monsoon....47
3.1.28 Water Quality Index of Pre-Monsoon and Monsoon of 2021....47
3.1.29 Water Quality Index of Pre-Monsoon and Monsoon of 2022....48
3.2 State of Air Quality in Dhaka....50
3.2.1 Status of PM_1....51
3.2.2 Status of $PM_{2.5}$....52
3.2.3 Status of PM_{10}....61
3.2.4 Weekly Concentration of $PM_{2.5}$ and PM_{10}....68
3.2.5 Ratio of $PM_{2.5}$ and PM_{10}....68
3.2.6 Diurnal Concentration of $PM_{2.5}$ and PM_{10}....70

3.2.7 Monthly Concentration of $PM_{2.5}$ and PM_{10}....................70
3.2.8 Cluster Analysis....................71
3.2.9 Correlation Among $PM_{2.5}$ and PM_{10}....................72
3.2.10 Correlation between US Embassy Dhaka, CAPS-USAID Project data....................74
3.3 Status of Noise....................74
CHAPTER FOUR: CIVIL SOCIETY AND COMMUNITY PERCEPTION....................80
4.1 River Talkies....................80
4.2 Dialogues....................84
4.3 Community Meetings....................86
4.4 School Workshops....................89
4.5 River Festivals....................90
4.6 River Carnival....................95
CHAPTER FIVE: POLICY AND LEGAL FRAMEWORK....................98
5.1 Legal Aspects of Buriganga River Pollution....................98
5.2 Analysis of legislative landscape 99
5.3 Analysis of Court Orders....................100
5.4 Government Initiatives of Reducing Water Pollution....................101
5.5 Major Policies and Laws....................102
5.5.1 Water Resource Planning Act, 1992....................102
5.5.2 Bangladesh Environment Conservation Act, 1995....................103
5.5.3 Water Supply and Sewerage Authority Act, 1996....................103
5.5.4 Environment Conservation Rules, 2023....................103
5.5.5 Noise Pollution Control Rule, 2006....................104
5.5.6 Bangladesh Water Act, 2013....................104
5.5.7 Water Rules, 2018....................105
5.5.8 The Playgrounds, Open Spaces, Parks, and Natural Wetlands Conservation Act-2000....................105
5.5.9 The National River Conservation Commission Act, 2013....................106
5.5.10 Brick Manufacturing and Brick Kilns Establishment Act, 2013....................106
5.5.11 Road Transportation Act, 2018....................106
5.5.12 National Environment Policy, 2018....................107
5.5.13 Air Pollution Control Rules....................107
5.5.14 Summary of Policy and Legal Documents of Pollution Control and Environmental Governance....................109
CHAPTER SIX: RECOMMENDATION AND CONCLUSION....................111
6.1 Significant findings of the Study....................111
6.2 Recommendations....................112
6.2.1 Recommendations for Water Pollution Reduction....................112

6.2.1.1 Short Terms Strategies for Water Pollution Reduction......................................112
6.2.1.2 Midterms Strategies for Water Pollution Reduction..113
6.2.1.3 Long Terms Strategies for Water Pollution Reduction.......................................113
6.2.2 Recommendations for Air Pollution Reduction..114
6.2.2.1 Short Terms Strategies for Air Pollution Reduction..114
6.2.2.2 Midterms Strategies for Air Pollution Reduction..114
6.2.2.3 Long Term Strategies for Air Pollution Reduction..114
6.2.3 Recommendations for Noise Pollution...115
6.3 Conclusion..115
REFERENCES..117
Annex – A: Water Quality Dataset...128
Annex – B: Air Quality and Noise Level Dataset...130
Annex – C: Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) Project Line........................154

List of Tables

Table 1: Water Quality Data Collection Date......15
Table 2: The Situation of Heavy metal Contamination in Pre-monsoon Season in the Last Two Years......32
Table 3: The Situation of Heavy metal Contamination in Monsoon Season in the Last Two Years......38
Table 4: The situation of Heavy metal contamination in post-monsoon season in last two years.41
Table 5: The situation of Heavy metal contamination in dry seasons of the last two years......44
Table 6: Annual concentration of PM_1, $PM_{2.5}$ and PM_{10} in 10 selected sites of Dhaka City......51
Table 7: The seasonal concentration of PM_1 over 10 locations of Dhaka city......52
Table 8: The seasonal concentration of $PM_{2.5}$ over 10 locations of Dhaka city......55
Table 9: The seasonal concentration of PM_{10} over 10 locations of Dhaka city......61
Table 10: Correlation Among $PM_{2.5}$ and PM_{10} and selected meteorological parameters......73
Table 11: Equivalent noise level (Leq) and Ln value of Noise......75
Table 12: Land use and Shift wise Noise level exposure (%) in Dhaka for the Month of April 2021 to March 2022......76

List of Figures

Figure 1: Research Design of the Study.....5
Figure 2: The river stretch studied with sampling points of the Buriganga and Dhaleswari River...9
Figure 3: Location MAP of Air Quality and Noise Level Data Collection at Dhaka City.....10
Figure 4: Methodology Flow Diagram of Air, Water & Noise.....13
Figure 5: Water Quality Sample Collection at Sadarghat.....14
Figure 6: Air Quality Monitoring Device.....16
Figure 7: Noise Level Meter.....17
Figure 8: Basic steps of CCME WQI Calculation.....19
Figure 9: Workflow of water quality analysis.....23
Figure 10: The average variation of the pH at the study sites in 2021.....24
Figure 11: Amount of TSS (Total Suspended Solids) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021.....25
Figure 12: Number of COD (Chemical Oxygen Demand) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021..... 26
Figure 13: Amount of BOD (Biological Oxygen Demand) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021.....27
Figure 14: Amount of Ammonia (NH3) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021.....28
Figure 15: Amount of Oil and Grease in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021.....29
Figure 16: Amount of Sulphides in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021.30
Figure 17: Amount of Phenol in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021....30
Figure 18: Amount of Cadmium in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021.31
Figure 19: Comparison of pH Test Results of 2021 and 2022 Pre-Monsoon. 33
Figure 20: Comparison of TSS Test Results of 2021 and 2022 Pre-Monsoon.....33
Figure 21: Comparison of COD Test Results of 2021 and 2022 Pre-Monsoon.....34
Figure 22: Comparison of BOD Test Results of 2021 and 2022 Pre Monsoon.....34
Figure 23: Comparison of Ammonia Test Results of 2021 and 2022 Pre Monsoon.....35
Figure 24: Comparison of Oil & Grease Test Results of 2021 and 2022 Pre-Monsoon.....35
Figure 25: Comparison of Sulphides Test Results of 2021 and 2022 Pre-Monsoon.....36
Figure 26: Comparison of Phenol Test Results of 2021 and 2022 Pre-Monsoon.....36
Figure 27: Comparison of Cadmium Test Results of 2021 and 2022 Pre-Monsoon.....37
Figure 28: Comparison of pH, TSS, BOD, COD, NH3, Oil and Grease, Phenol and cadmium for the Monsoon season between the years 2021 and 2022.....40
Figure 29: Comparison of pH, TSS, BOD, COD for the post-monsoon season between the years 2021 and 2022.....42

Figure 30: Comparison of pH, TSS, BOD, COD and phenol for the pre-monsoon season between the years 2021 and 2022....................43
Figure 31: Seasonal variations of pH, BOD, COD and suspended solids in 2021....................45
Figure 32: Temporal dynamics suspended solids during 2013-2022....................45
Figure 33: CCME Water Quality Index of 2021....................46
Figure 34: CCME Water Quality Index of 2022....................47
Figure 35: CCME Water Quality Index of Pre-Monsoon and Monsoon season, 2021....................48
Figure 36: CCME Water Quality Index of Pre-Monsoon and Monsoon season, 2022....................49
Figure 37: Comparative scenarios of CCME Index of Water quality between pre-monsoon and monsoon seasons of 2021 and 2022....................49
Figure 38: Workflow diagram of air quality analysis....................50
Figure 39: Comparison among seasonal concentration PM_1 over 10 locations of Dhaka city....................52
Figure 40: Annual Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City....................54
Figure 41: Comparison among seasonal concentration $PM_{2.5}$ over 10 locations of Dhaka city....................56
Figure 42: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City During Pre-monsoon (April to May 2021, March 2022)....................57
Figure 43: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City During Monsoon (June to August 2021)....................58
Figure 44: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City During Post Monsoon (September to November 2021)....................59
Figure 45: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City during the Winter season (December 2021 to February 2022)....................60
Figure 46: Annual Concentration of PM_{10} in 10 Location of Dhaka City (April 2021 to March 2022)....................62
Figure 47: Comparison among seasonal concentration PM_{10} over 10 locations of Dhaka city....................63
Figure 48: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Pre-monsoon (April to May 2021, March 2022)....................64
Figure 49: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Monsoon (June to August 2021)....................65
Figure 50: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Post-monsoon (September to November 2021)....................66
Figure 51: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Winter (December 2021 to February 2022)....................67
Figure 52: Weekly Concentration of $PM_{2.5}$ and PM_{10}....................68
Figure 53: Location wise Ratio of $PM_{2.5}$ and PM_{10}....................69
Figure 54: Seasonal Ratio of $PM_{2.5}$ and PM_{10}....................69
Figure 55: Diurnal Concentration of $PM_{2.5}$ and PM_{10}....................70
Figure 56: Monthly Concentration of $PM_{2.5}$ and PM_{10}....................71

Figure 57: Dendrogram using averaging linkage (between group) of PM2.5 (a) and PM10 (b)....72
Figure 58: Table 10 Pearson correlation between PM2.5 and PM10..73
Figure 59: Correlation between US Embassy Dhaka, CAPS-USAID Project data............................74
Figure 60: Annual Equivalent Continuous Sound Level in 10 Location of Dhaka city (April 2021 to March 22)..78
Figure 61: River Talkie 1 - Urbanization of Dhaka along..83
Figure 62: River Talkie 2 - Influence of rivers on Culture, Art and Artist......................................83
Figure 63: River Talkie 3 - Youth and River..83
Figure 64: River Talkie 4 - Water pollution and the problems of women....................................83
Figure 65: River Talkie 5 - The role of rivers in the...83
Figure 66: River Talkie 6 - Laws to protect Rivers...83
Figure 67: River Talkie 7 - Health impact of river pollutions..84
Figure 68: River Talkie 8 - River-centric life and livelihoods...84
Figure 69: River Talkie 9 - Rivers for communication...84
Figure 70: Dialogue 1 : River Pollution by Tannery Industries...86
Figure 71: Dialogue 2: Empowering NRCC to comply with court orders to protect River Pollution...86
Figure 72: Community meeting 1- To Formulate a coalition of the CBO's/ NGOs in the bank of river Buriganga...87
Figure 73: Community meeting 2: Buriganga River..87
Figure 74:Community meeting 3: Buriganga River pollution and its remediation........................88
Figure 75:Community meeting 4: Balu River pollution and its remediation................................88
Figure 76: Community meeting 5: Balu River pollution and its remediation...............................88
Figure 77: Community meeting 6: Turag River pollution and its remediation.............................88
Figure 78: Community meeting 7: Balu River pollution and its remediation...............................88
Figure 79: Community meeting 8: Balu River pollution and its remediation................................88
Figure 80: Community meeting 9: Turag River pollution and its remediation.............................89
Figure 81: School Workshop 1...90
Figure 82: School Workshop 2...90
Figure 83: Inauguration of the Buriganga River Festival..92
Figure 84: Inauguration of the Buriganga River Festival..92
Figure 85: Mime show on the Occasion of Buriganga River Festival..92
Figure 86: Dingi Boat Race of the Buriganga River Festival..92
Figure 87: Cycle Rally on the Occasion of Buriganga River Festival..92
Figure 88: Children Drawing Competition on the Occasion of Buriganga River Festival..............92
Figure 89: Speech of the Festival- Buriganga A Living Entity (Buriganga River Festival)................93
Figure 90: Tales of Buriganga (Buriganga River Festival)...93
Figure 91: Chief Guest Visiting the Stall (Buriganga River Festival)..93

Figure 92: Different Stalls (Buriganga River Festival) 93
Figure 93: Cultural Program (Buriganga River Festival)...93
Figure 94: Closing and Prize Distribution (Buriganga River Festival)...93
Figure 95: Inauguration (Balu River festival)..94
Figure 96: Inauguration (Balu River Festival)...94
Figure 97: Lathi khela (Balu River Festival)...94
Figure 98: Balish (pillow) game for women: (Balu River Festival)...94
Figure 99: Football match (Balu River festival)...94
Figure 100: Boat race (Balu River Festival)..94
Figure 101: Prize Distribution (Balu River Festival)..95
Figure 103: Cultural Program (Balu River Festival)..95
Figure 103: Winner of the boat race (Balu River Festival)...95
Figure 104: Opening Session (Buriganga River Carnival)...96
Figure 105: Opening Session (Buriganga River Carnival)...96
Figure 106: Rally of the (Buriganga River Carnival)...97
Figure 107: Boat Rally (Buriganga River Carnival)..97
Figure 108: Boat Rally (Buriganga River Carnival)..97
Figure 109: Boat Rally (Buriganga River Carnival)..97
Figure 110: Water governance responsible institutions in Bangladesh (Arifuzzaman et al.2019) 102
Figure 111: Policy and legal framework of Pollution and environmental governance...............119

Acronyms and Abbreviations

AQI	Air Quality Index
BAPA	Bangladesh Poribesh Andolon
BD	Bangladesh
BIRDEM	Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders
BOD	Biological Oxygen Demands
CAPS	Centre for Atmospheric Pollution Studies
CBO	Community Based Organization
CCME	Canadian Council of Minister of the Environment Water Quality Index
CEGIS	Centre for Environmental and Geographic Information Services
COD	Chemical Oxygen Demands
CPI	Counterpart International
CS	Civil Society
CSO	Civil Society Organization
dB	Decibel
DG	Directorate General
DNCC	Dhaka North City Corporation
DO	Dissolved Oxygen
DoE	Department of Environment
DSCC	Dhaka South City Corporation
EC	Executive Committee
ECA	Environmental Conservation Act
ECR	Environmental Conservation Rules
EIA	Environmental Impact Assessment
EQS	Standard for Environmental Quality
ETP	Environmental Treatment Plant
FCDO	Foreign, Commonwealth & Development Office
GOB	Government of Bangladesh
Max	Maximum
Min	Minimum
MS	Microsoft
NGO	Non-Governmental Organization
NIP	National Industrial Policy
NPI	Nemerow's Pollution Index
NSF	National Sanitation Foundation
NTI	New Tannery Industry

OG	Oil and Grease
OTI	Old Tannery Industry
PAR	Promoting Advocacy and Rights
pH	Potential of Hydrogen
PIL	Public Interest Litigation
PM	Particulate Matters
Rec	Record
SD	Secure Digital Card
SDS	Shyampur Dyeing Spot
SoDE	State of the Dhaka Environment
SPSS	Statistical Package for the Social Sciences
SS	Sadarghat Spot
TDS	Total Dispensed Solids
TSS	Total Suspended Solids
UN	United Nations
USAID	United States Agency for International Development
VIP	Very Important Person
WARPO	Water Resource Planning Organization
WASA	Water Supply and Sewerage Authority
WBB	Work for a Better Bangladesh
WHO	World Health Organization
WKB	Waterkeepers Bangladesh
WQI	Water Quality Index

Foreword

Waterkeepers Bangladesh (WKB) Consortium carried out an anti-pollution advocacy initiative and co-created a project together with Counterpart International (CPI) called "Promoting democratic governance and collective advocacy for environmental protection in Dhaka city" under "Promoting Advocacy and Rights (PAR)" activity of United States Agency for International Development (USAID) and Foreign, Commonwealth and Development Office (FCDO) between January 2021 and July 2023.

Waterkeepers Bangladesh formed the consortium with the Department of Geography and Environment, Jahangirnagar University, Savar, Dhaka, and the Centre for Atmospheric Pollution Studies (CAPS) at the Department of Environmental Science, Stamford University, Bangladesh. This report incorporated scientific data analysis of air and noise pollutions from 10 different locations in Dhaka City and the quality of water monitored in 4 locations in Buriganga and Dhaleshwari rivers targeting Tannery, Dyeing and naval vessels' pollutions to Dhaka Rivers. The findings were validated periodically by the experts and relevant government agencies.

In addition to these analyses, we incorporated summary of the analysis of policy and implementation loopholes on water, air and noise pollutions considering the existing legal frameworks and court orders. The full reports were published at the Supreme Court Auditorium in 2022.

This project was also designed to identify the Community Based Organizations (CBO) by the banks of 3 Dhaka rivers and formed Buriganga, Turag and Balu River Coalitions. The coalitions mobilized thousands of community people against river pollutions and gathered their perspectives through several consultation meetings. A journalists' coalition was also formed to engage media with this effort. Through implementing an innovative idea to organize River Talkies (open stage talk show on the riverbanks); series of talk-show, published live in social media platforms, we gathered opinions of the experts and civil society leaders. All those recommendations were included in the SODE report.

We hope, this report will provide highly credible information, data and recommendations that will help pertinent stakeholders including the government to understand accurate issues to address while taking any comprehensive and inclusive actions against air, noise and water pollutions in Dhaka. Students, researchers and social advocates can use these also as their tools of teaching, campaigning and advocacy works.

We would like to thank all the experts, CBO & CSO Leaders, Coalition Members, Consortium Members, Project Staffs and Volunteers. Special gratitude to the people who participated in the activities along with both the participants and supporters from the government agencies to accomplish the project successfully. Finally, we must recognize the fact that, without the technical support from CPI and financial support from USAID and FCDO, the mammoth works under this project could not be designed and implemented. Our sincere gratitude to the people of the US and UK.

Sharif Jamil
Coordinator, Waterkeepers Bangladesh and
Member Secretary, Dhoritri Rokhhay Amra (DHORA)

Acknowledgement

We would like to recognize the invaluable contributions to the development of the State of Dhaka Environment (SODE) 2021-2022 report. This report is a comprehensive analysis of the issues of water, air, and noise pollutions in Dhaka city. It recognizes that addressing environmental pollutions require a comprehensive approach where it engages scientific expertise, community people, civil society perspectives and policy interventions. By integrating these elements, the report hopes to facilitate the formulation and implementation of effective strategies that can lead to a sustainable and attainable reduction in the pollution levels. Furthermore, by providing detailed information about the quality of air, noise, and water in different areas of the city and its rivers, the report hopes to strengthen the capacity and empower the communities and CSOs to be engaged in advocacy efforts for bringing positive changes towards another Dhaka, a city where people can breathe fearlessly, everybody makes river the face again and peace around the streets and neighbourhoods. The report recognizes the importance of community involvement in tackling environmental pollutions and provides a valuable resource for those who are looking for mobilizing public support on this important cause.

We are deeply grateful to the officers, researchers, authors, contributors and media representatives who participated in data validation workshops and wholeheartedly supported the development of this report. We are very thankful to the DoE, NRCC, WASA, DNCC, DSCC, DMP, district administration, Intertek and other institutions, and individuals who contributed time, data, information and support that played significant role in developing this report. Finally, we would like to express our sincere gratitude to the partner organizations, associate members and the organizations at the community levels for their generous support and participation. We highly value and appreciate all including the readers with humble acknowledgement here.

Sharif Jamil
Lead, Waterkeepers Bangladesh Consortium

Executive Summary

The United Nations has established 17 Sustainable Development Goals (SDGs) aimed at transforming the world towards an economic growth without harming the environment and people. While ensuring clean water and air everywhere are at the core of the philosophical understanding of delivering a safe, healthy and liveable planet for the future generation. Bangladesh, particularly its capital Dhaka, the most densely populated city in the world is struggling to its existence due to tremendous air and noise pollutions. In addition to shrinking rivers, canals and retention ponds of this mega city, the rivers around Dhaka are highly polluted by the discharge of untreated effluents from the industries and waste disposal by different authorities. To improve the condition of the water, air and noise quality of Dhaka city, WKB Consortium has planned scientific study, policy analysis and various consultation processes to gather information and recommendations from the people to incorporate in a State of Dhaka Environment (SoDE) report.

The SoDE report intends to establish a link between scientific data, public perception, civil society recommendations, policies and practices with the objective of promoting the efforts to reduce environmental pollution in the city. The report aims to generate evidence that can support campaigning and advocacy efforts within the community to combat environmental pollutions. It is expected that this publication will be beneficial for individuals and organizations responsible for environmental protection, both within and outside of the government including the civil society, researchers and concerned citizens.

There is not enough dissolve oxygen in the water of Dhaka rivers for the aquatic life to survive during the lean period. Since the tannery industries moved to Hajaribag in Dhaka during early 70s from Narayangonj, it has been discharging untreated tannery wastes directly to the river Buriganga through Hajaribag canal and Haikkar Khal. After long involvement of people, government and court, in 2016 the tannery industries were shifted to Harindhara at Savar by the bank of Dhaleshwari, an upstream river of Buriganga. Therefore, it was important to check the condition of tannery pollutions to Dhaka Rivers and water from two points were brought under the scientific analysis. Similarly, water quality near the pollution from Shyampur industrial cluster of dyeing factories was under the purview of the project. In addition, the project analysed water quality around Sadarghat Terminal, largest river port in the country to gather information about the pollutions from the naval vassals. Intertek collected the samples and conducted the lab testing while the Department of Geography and Environment, Jahangirnagar University did the data analysis as an important member of the WKB Consortium.

A total of 108 water samples were collected during Pre-monsoon, Monsoon, Post-monsoon, and Dry season from Buriganga and Dhaleshwari rivers to check eight parameters, including pH, TSS, COD, BOD, NH3, OG, S2-, C6H6O, and Cd, for quality monitoring. The collected data indicated high contamination of heavy metal in the water of the Buriganga river, Dhaka. Most of the locations received a poor rank in the Canadian Council of Ministers of the Environment (CCME) water quality index, indicating alarming levels of industrial and urban pollution that need to be controlled. If not addressed, aquatic life and human reliance on the water source will continue to face water-related issues.

The situation of air and water pollution in and around Dhaka had become unbearable. In the Air Quality Index (AQI), Dhaka had been consistently performing very low. Sometimes it went alarming and became a public health concern for the city dwellers. On the other hand, a recent report by the United Nations Environment Program (UNEP) identified Dhaka as the most noise-polluted city in the world.

WKB Consortium member CAPS conducted the air and noise quality study. For 52-weeks, from April 2021 to March 2022, WKB consortium collected weekly data on air quality and noise level from 10 distinct locations in Dhaka city at Shahbag, Motijheel, Ahsan Manjil, Dhanmondi-32, Gulshan-2, Parliament area, Utara, Tejgaon, Agragaon, and Mirpur. In order to obtain data on PM_1, $PM_{2.5}$, and PM_{10}; CAPS collected 520 samples in total. According to the collected data, Shahbag had the highest annual mean concentrations of $PM_{2.5}$ and PM_{10}, at 91 $\mu g/m^3$ and 147 $\mu g/m^3$, respectively. The Parliament area has the lowest annual mean concentrations of $PM_{2.5}$ and PM_{10}, at 59 $\mu g/m^3$ and 88 $\mu g/m^3$, respectively. The annual Bangladesh National Ambient Air Quality Standard (15 $\mu g/m^3$ for $PM_{2.5}$ and 50 $\mu g/m^3$ for PM_{10}) is exceeded by the concentrations at all sampling sites. In addition, winter was discovered to have the lowest quality of air among the four seasons.

The data collected indicates that for all 10 locations in Dhaka city, the Max noise range is 130 dBA to 133 dBA and the Min noise range is 31.7 dBA to 39.3 dBA. The noisiest area in Dhaka is Gulshan-2 (95.4 dBA), whereas Tejgaon (89 dBA) is the least noisy place. Despite Tejgaon's relatively low noise level, its Leq (equivalent noise levels) value is excessively high. This information is based on an analysis of Leqs. With an evaluated range of 78.9-87.7 dBA, high traffic noise (L10) was observed. The computed values for mid-level noise (L50) varied from 65.9 to 74.4 dBA. The computed values of the background noise (L90) range from 53.9 to 59.1 dBA, which is relatively low. All the air, noise and water quality data were periodically validated by Data Validation Workshops.

Academic from the Department of Law in the University of Dhaka studied the policy and legal frameworks to identify the policy loopholes while a practising lawyer in the Supreme Court of Bangladesh analysed the court orders to identify the implementation loopholes. A publication named, “An Analysis of the Legislative Landscape and Court Orders on Air, Noise and Water Pollution” was unveiled at the auditorium of the Supreme Court of Bangladesh by the Attorney General. Summary of the analyses is incorporated in the SODE report.

To gather views from the CSOs on the river pollution, 9 RiverTalkies were organized where experts, CSO and CBO leaders took part to the discussions. There were discussions and conferences that brought tannery owners, government agencies, community people, students and media representatives to reveal the realities and reflect on probable recommendations to way out possible pathways to stop river pollution.

Out of 254 CBOs a total of 82 were identified by the banks of Buriganga, Turag and Balu and formed Buriganga, Turag and Balu River coalitions to work together. They organized 9 community consultation meetings to discuss about the ground realities and possible recommendations against river pollution. Two River Festivals and 1 River carnival not only engaged Mayor of DNCC, lawmaker of riverbank constituency, politicians and government policymakers, it also brought thousands of riverbank people by the river and spread awareness against river pollutions among the people to make rivers our front yard. Recommendations from the community is an important part of this report.

Hence, through specific recommendations, this report has created a platform for all stakeholders involved in environmental issues to work together to raise awareness about environmental pollution, engage with policymakers, and promote evidence-based campaign and advocacy.

To reduce water pollution, comprehensive initiatives need to be undertaken that engage community people, civil society, researchers, industrial sector, government and politicians for the implantation of a robust action plan in phases incorporated and guided by the national plans, policies, legal frameworks and court orders.

Similar approaches are crucial for tackling air pollution effectively. Some immediate measures like fostering cooperation among Dhaka City Corporations, WASA, Fire Service and Civil Defence authority, and Department of Environment (DoE) and National River Conservation Commission (NRCC) as directed by the honourable High Court, implementing proper solid waste management plan, shutting down of illegal kilns, controlling personal car usage and unfit vehicles, promoting tree plantation, increasing surface water bodies, enforcing a "Clean Air Act," raising awareness through media and people etc. are recommended.

To combat noise pollutions, raising awareness and educating the people about the consequences of noise pollution and the rules governing it are essential. The legal steps to control noise pollutions are extremely necessary to be properly implemented.

In some cases, the legal provisions concerning air, noise and water pollution are found to be vague, inconsistent and incoherent. The laws provide ample power to the executive and administrative authorities without containing any accountability provision in cases of irregularities and malpractices in discharging their powers and functions. Such enormous power without responsibility acts as challenge to hold the implementing stakeholders accountable. The study suggests possible recommendations in the existing laws and rules that will, arguably, enhance the feasibility of those laws and rules to function effectively.

While the Courts' approach is mostly affirmative towards conservation and preservation of environment - pollution is increasing which is acutely contributing to the environmental damage at an uncontrollable rate; a situation which Courts' optimism is not enough to address. Lack of having adequate and effective legislations and policy is a major concern, and on that note this, participation of the corporations and people at large is highly essential for creating a balance between economic growth and environment damages. Sometimes, faulty implementation of the verdicts of court further aggravated the situations.

Awareness among the local people is essential, as they are the primary victim of river pollution and the most dependent stakeholder group. The women and youth group should be coming forward with actions against environmental pollutions. Locally led implementation approaches of river protection efforts can improve the status.

For the public health, sanity, and wellbeing of the population, and for the future of our children, it is time that we all take this problem seriously and acknowledge the crisis for forwarding solutions. The Government should come up with a strong policy of zero-tolerance towards the environmental pollution coupled with political willingness as to lead the plans and efforts. The CSOs and NGOs could play significant role in advocating legal and policy reforms and formulations concerning environment. Bangladesh government has taken some initiatives both in terms of formation of policies and legal frameworks. However, they are not adequate, coherent and there are some severe loopholes and inconsistencies in the formation of policies including implementation efforts. A holistic approach can put the pathways forward to curb water, air and noise pollutions in Dhaka.

CHAPTER ONE: INTRODUCTION

Waterkeepers Bangladesh (WKB) Consortium during the implementation of the project "Promoting democratic governance and collective advocacy for environmental protection in Dhaka city" supported by USAID, FCDO and CPI, aimed to scientifically analyse water, air, and noise pollution in Dhaka and offered valuable insights for policymakers to foster sustainable environmental development in and around the city. The report produced by the analysis delves into the current environmental conditions of Dhaka, focusing on water, air, and noise quality.

1.1 Water Pollution

Bangladesh's rivers have suffered from human interference since the country's early stages of development. The country's metropolitan centres still largely rely on waterways in this era of intensive industrialization since the historical civilization of this region evolved on transportation via rivers (Ali et al., 2009). The capital of Bangladesh, Dhaka, is surrounded by three rivers i.e., Buriganga, Turag and Balu., The Buriganga River is tide influenced and runs through its west and south. The Buriganga riverside served as the focal point for early settlements, which helped to form the city's urban environment, ecology, and economy. Turag and Balu River surrounded the Dhaka City from the east. Despite the human interference, these rivers have continued to provide various water-related amenities, including groundwater recharge, cultural significance, transportation, drainage, and flood control systems. In addition to all upstream pollutions carried by the Turag River, the pollutions from the naval vessels around the largest river port Sadar Ghat, Buriganga River was being highly polluted by the Tannery and Textile waste.

Dhaka, the metropolis of Bangladesh, relies heavily on the Buriganga River for its socioeconomic structure. Unfortunately, this river is one of the most contaminated in the world due to its high levels of pollution. Several studies have shown that heavy metal poisoning is exacerbated by water pollution from sources such as factories, farms, and unsuitable garbage dumps (Wei et al., 2022; Désirée et al., 2021). Toxic metals such as lead, mercury, and cadmium are released by industries and end up in water supplies (Qi et al., 2022). Furthermore, the use of chemical fertilisers and pesticides in agriculture causes runoff to carry pollutants into waterways. Additionally, heavy metals from home sewage and solid waste end up in water supplies due to inappropriate trash management. Heavy metal pollution poses serious risks to environmental health on several fronts. There is a cumulative effect of these pollutants in living things (Custodio et al., 2021). As they progress up the food chain, their concentrations grow dramatically at each successive trophic level (Désirée et al., 2021). It follows that heavy metals have deleterious effects on metabolic and cellular processes in aquatic creatures. In addition to increasing susceptibility to disease and predators, they can also interfere with reproduction, affect behaviour patterns like eating or mating rituals, and weaken immunological responses (Wei et al., 2022).

Because of the garbage emitted by thousands of industries and other commercial polluters in the Dhaka Metropolitan region, the Buriganga River is extremely polluted (Whitehead et al., 2019). Recent research has found numerous signs of heavy metal contamination in the Buriganga River and its detrimental effects. Metals like Fe, Cr, Zn, Ni, Cu, and Pb were detected in the Buriganga samples investigated by Hossain et al. (2021) at concentrations that are unsafe for human consumption. This investigation therefore confirmed the presence of harmful heavy metals in fish. Bioaccumulation of metals and an alarmingly high concentration of metals in Buriganga's sediments, vegetation, and fishes were also reported in a separate study by Majed et al. (2022). To investigate potential health risks associated with consuming fish from the Buriganga River, Mohanta et al. (2022) utilised Long-Evans rats. Histopathological abnormalities were observed in the rats' livers and kidneys after exposure to the fishes. Therefore, it is crucial to examine the possibility that the hazardous chemical in Buriganga water could initiate harmful effects on different types of biotas, as described by Billah et al., (2022).

1.2 Air Pollution

Air pollution is one of the varieties of manmade environmental disasters that are currently taking place all over the world. Air pollution can be defined as a situation in the atmosphere where certain substances exist at concentrations significantly higher than their usual ambient levels, resulting in measurable impacts on humans, animals, vegetation, or materials. 'Substances' refers to any natural or manmade chemical elements or compounds capable of being airborne (Harrison et al., 2014). These may exist in the atmosphere as gases, liquid drops, or solid particles. It includes any substance whether noxious or benign; however, the term 'measurable effect' generally restricts attention to those substances that cause undesirable effects. Major sources of outdoor air pollution are brick kilns, motor vehicles, power plants, and trans-boundary air pollution (Khandker et al., 2022). Air quality has deteriorated both due to human activities and natural phenomena such as windblown dust particles etc. (Razib et al., 2020; Hossen and Haque, 2018). Recently, air pollution has received priority among environmental issues in Asia as well as in other parts of the world. Exposure to air pollution is the main environmental threat to human health in many towns and cities. Bangladesh is in the top position in the Air Quality Report of 2019, 2020, 2021 and 2022 in terms of average annual PM2.5 concentration (μg/m3) for regional capital cities in descending order, where Dhaka city is in the 2nd position in the year of 2019, 2020, 2021 and 5th in 2022 among the capital cities of the world (IQAir, 2019; IQAir, 2020; IQAir, 2021; IQAir, 2022). Apart from this, the latest report released by IQAir states that in 2022 the average of $PM_{2.5}$ in the air of Bangladesh was found 65.8 $\mu g/m^3$ which is 13.16 folds higher than the standard level which is 5 micrograms per cubic meter set by the World Health Organization (WHO) (IQAir, 2022). $PM_{2.5}$ denotes ≤2.5 μm and PM_{10} denotes the particles with an aerodynamic diameter of ≤10 μm (Nayeem et al., 2019). Particulate matters originate from a variety of sources, such as power plants, industrial processes, transports, brick kilns, biomass burning, wind-blown dust, sea spray, and also, they are formed in the atmosphere by the transformation of gaseous emissions. Their chemical and physical compositions depend on the characteristics of the emission sources, location area, time of year, and prevailing weather conditions (Begum et al., 2010; Haque et al., 2017). Particle conversions through chemical processes in the atmosphere by burning of biomass, gas, and fossil fuels is the main sources of the $PM_{2.5}$ (Nayeem et al., 2020) and while coarse particles ($PM_{2.5}$-10) are the result of mechanical activities such as wind-blown dust, grindings, re-suspended road dust, etc. (Rana et al., 2016). $PM_{2.5}$ concentrations in mixed and motorized areas were on an average higher than the non-motorized and vehicle-free areas (Nayeem et al., 2019; Hossain et al., 2019). Emissions from the brick kiln are the major contributors to air pollution in Dhaka especially in the dry season. A number of studies found strong positive relationship with Brick kilns and $PM_{2.5}$ (Nayeem et al., 2019). Salam et al. (2015) found that average $PM_{2.5}$ mass was 136.1µg/m³ during day time and 246.8µg/m³ during night time. Salam et al., 2015 revealed weekends had lower concentrations than weekdays due to less vehicular traffic in the streets and aerosol particles concentrations were about 15.0% (ranging from 9.4% to 17.3%) higher during traffic peak hours (6:00am-8:00pm) than off hours (8.00pm-6.00am) (Salam et al., 2015).

1.3 Noise Pollution

Noise pollution is widely recognized as a significant environmental problem, like other environmental concerns (Haq et al., 2012). "Loud and unpleasant" sound that exceeds the acceptable level and creates annoyance can be defined as a noise (Razzaque et al., 2010). Extremely annoying, mood swings, mutual relationship ruining, increasing the fluctuations, hearing impairment, high blood pressure, irregular heartbeat, headache, indigestion, peptic ulcers, and insomnia is caused by the noise pollution, which is called a silent killer (Chaudhary and Chaudhary., 2020). To be more specific, noise pollution is characterized by the excessive and disruptive levels of sound that can lead to potential hearing loss in both humans and animals (Jariwala et al., 2017).

Sound intensity is measured in decibels. dB is a symbol used to represent decibel. The World Health Organization (WHO) states that typically, noise levels of 60 dB can temporarily render people deaf while noise levels of 100 dB can result in total deformity. 360 million people, or more than 5% of the world's population, have hearing impairment, according to the WHO. The cost of $750 billion annually has an impact on the lives of those who suffer from hearing loss because hearing impairments are not given enough attention. The WHO established the max noise level for the day (6 a.m. to 9 p.m.) at 45 dB and for the night (9 p.m. to 6 a.m.) at 35 dB.

It is considered harmful if the noise level exceeds 80 dB. The loudspeaker noise ranges from 90 to 120 decibels, industrial noise is 80 to 90 decibels, restaurants and movie theatres are 75 to 90 decibels, fair festivals are 85 to 90 decibels, scooters and motorcycles are 87 to 90 decibels, and trucks and buses are 90 to 100 decibels. These are the sounds that are typically produced during daily activities. Noise levels over 45 decibels prevent individuals from falling asleep. Acute hearing is caused by the 85 dB levels' acidity, and ear discomfort begins at level 120 dB.

1.4 Role of Civil Society and Communities in Pollution Advocacy

If individuals want to bring positive change in society, they require the tools to effectively advocate for it. Civil Society (CS) plays a crucial role in enabling this mechanism by actively mobilizing public support for common interests. Non-Government Organisations (NGOs) and CSOs not only participate in governance but also act as a catalyst for enhanced international cooperation. CS groups have long been acknowledged as "partners" of the UN system due to their crucial role in service delivery and implementation, particularly in environmental discussions (Gemmil et al., 2002). At its broadest definition, CS refers to a sector of social engagement that is accessible to the general public, excluding official government activities (Meidinger, 2001).

Societies can make a substantial contribution to environmental conservation by increasing people's awareness of the importance of managing and preserving natural resources through education and outreach efforts.

In middle- and low-income countries, disadvantaged and marginalized populations often bear the greatest burden of environmental effects on health, as well as socioeconomic systems. Communities residing far from influential decision-makers face numerous challenges in their efforts to address pollution. Many of these community people lack the necessary advocacy skills to form strategic alliances and effectively engage with government officials. They may also be unaware of their rights to access information about pollution or participate in policymaking, and in many cases, these rights are limited or absent. Environmental rights, including access to information, public participation, and justice, play a critical role not only in promoting effective environmental governance but also in facilitating the development, implementation, and enforcement of anti-pollution laws. Through strategic utilization of these rights, CS and local communities can assess the environmental and social justice impacts of pollution. They can advocate for better compliance with environmental regulations, and actively contribute to the development of a movement focused on promoting pollution responsibility (Moses and Excell, 2020).

1.5 Aim and Objectives of the Study

Pollution has emerged as a major challenge of the twenty-first century, with Dhaka being severely affected. The city is becoming increasingly inhospitable, with dying rivers and toxic air posing various health hazards for its residents. The objective of the study is to establish a connection between scientific data, public perception, and policy to strengthen efforts aimed at mitigating environmental pollution in Dhaka city. To pursue this vision, the study attempts to collect baseline scientific data on various environmental components of Dhaka city including water, air, and noise quality. Simultaneously, the study explores citizen perception about the state of environment, reviews the existing policy gaps and identifies the potential avenues for advocacy. The scientific study of the environmental parameters assists in understanding about the state of environment in Dhaka city for further policy advocacy. With this aim, the study is open to developing a framework to allow integration between scientific information and people's perception to contribute better understanding of the state of environment. Thus, the report initiates a platform for all stakeholders related to environmental protection to come together enriching the report to inform policy makers and engage the community for evidence-based campaigning and advocacy.

The study aims to achieve the following objectives to address data gaps, inform policies and programs, and involve stakeholders effectively:

- Analyse the spatial and temporal variations of collected scientific data on water, air, and noise, comparing them with the standard indices of the study sites.
- Understand the perceptions of citizens and CSOs regarding the environment in Dhaka.
- Identify gaps in existing policies and institutions related to environmental protection.
- Generate evidence to support community-based campaigning and advocacy efforts aimed at reducing environmental pollution.

1.6 Research Design

Figure-1 shows the Research design of the study that has been illustrated in the following flowchart:

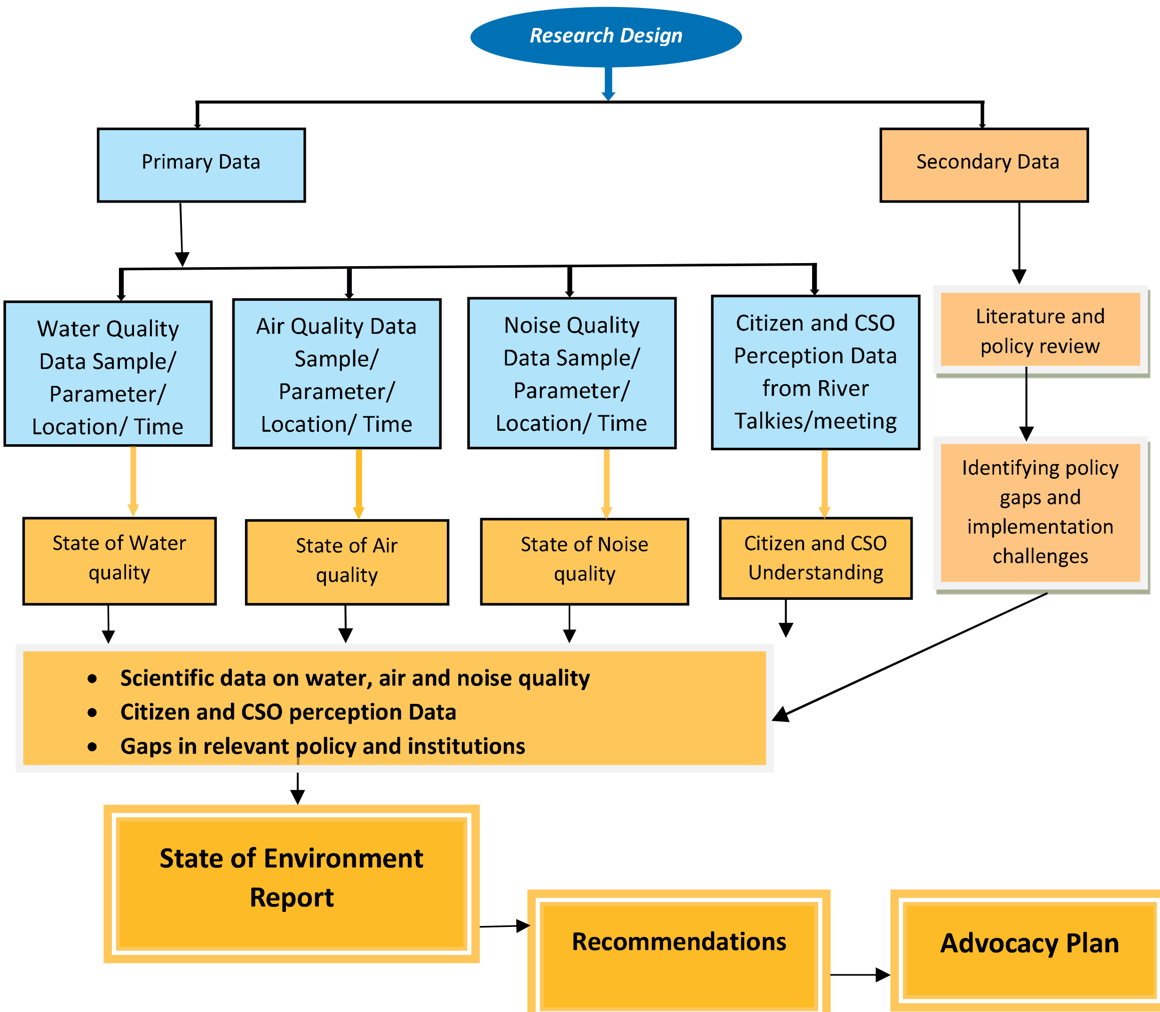


Figure 1: Research Design of the Study

1.7 Organization of the Report

The report is structured into six chapters. The first chapter provides a brief introduction, followed by the detailed methodology and discussion/analysis on the study area in the second chapter. The third chapter presents the scientific findings/results of analysis on the water, air, and noise quality of Dhaka city. In the fourth chapter, a critical analysis of CS and community perception is provided. The fifth chapter discussed on the policy and legal framework and illustrated major policies and laws of Bangladesh. The sixth chapter provides recommendations based on the previous discussions and analysis and made conclusion.

CHAPTER TWO: DATA AND METHODS

The first part of this chapter describes the physical and environmental settings and the rationale of the study area selection. The second and final part describes the data collection methods and procedures.

2.1 Rivers of Dhaka

Part of the Great Bengal Basin and the largest delta of the world, Bangladesh is a land of rivers – every city and district is established by the river, by the sediments carried by the Ganges – Brahmaputra – Meghna rivers. Dhaka is the capital of Bangladesh and the centremost district – surrounded by various rivers, notably the Buriganga, the Balu and the Turag.

Buriganga is considered the lifeline of Dhaka city, as it passes through the southwest outskirts of the city. Its average depth is 7.6 meters, and its max depth is 18 metres. The river originated from Dhaleshwari near Kalatia. Turag fell into the Buriganga and became the primary source of water rather than the original one. After travelling 27 kilometres, Buriganga is connecting again with Dhaleshwari near Munshiganj. The current Buriganga head near Chhaglakandi has silted up and is only open during floods, although the lower half remains open all year. The downstream connection with the Dhaleshwari varies depending on the location of the river; it is now located 3.22 kilometres southwest of Fatullah. The tough clays that line the southern margin of the Madhupur tract stabilise its route as it approaches Dhaka. Dhaka's economy relies heavily on Buriganga. It connects to the river through launch and country boats. During the dry season, large steamers are unable to ascend the river. Water contamination in the Buriganga River is at an all-time high. Tanneries in the Hazaribagh region appear to be the primary source of pollution. The dissolved oxygen level drops to near zero during the dry season, making the river poisonous.

Turag, earlier known as "Kohor Doriya" or "Big wetland", is another significant river of Dhaka city and an upper tributary of Buriganga river. Turag runs through Gazipur before joining Buriganga at Mirpur in Dhaka District. It comes from Bangshi River, a significant tributary of Dhaleshwari River and travels 75 km before ending up in Buriganga. The invasion of the Lohajang river in Tangail district drew the Turag River into the Jamuna system. It is accessible by boat round the year, despite only having a little flow throughout the dry season. Since the Assam earthquake in 1950, sediments from the Jamuna have infiltrated its valley almost as far south as Tongi Khal. Boro rice production is prevalent across the Turag valley south of the Mymensingh Trunk Road. It is one of the significant contributors to groundwater recharge in Dhaka, Bangladesh's most populous metropolis.

The Balu River flows mainly through the vast wetlands of Beel Belai and those to the east of Dhaka, eventually entering Shitalakshya at Demra. It has a slight connection with the Shitalakshya via the Suti Nadi at Kapasia and via the Tongi Khal with the Turag; it also links with the Shitalakshya near Kaliganj. During flood season, Balu conveys floodwater from the Shitalakshya and Turag, although it is mainly used for local drainage and small boat access. The lone natural way out of Bangla Motors, Farmgate, Mohakhali, Gulshan, Tejgaon, Baridhara, Rampura, Malibagh, and Basabo areas through Begunbari, Beraid, and Manda canals, Balu plays a significant part in the city's drainage system.

2.2 Sampling

Different sampling sites have been selected for water, air and noise quality as well as CS and community perception data collection and analysis. In the following sections the sampling locations have been described.

2.2.1 Water Quality Analysis

The Buriganga River's water quality has been continuously declining over time due to the extensive human activity in its vicinity. Its degree of pollution is now considered to be higher than that of other rivers in Bangladesh, making it one of the most severely contaminated rivers in the nation (Nadi et al., 2010). The Buriganga River experiences seasonal variations that result in fluctuations in several physiochemical properties. Parameters such as temperature, pH, DO (Dissolved Oxygen), BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), TDS (Total Dissolved Solids) and TSS (Total Suspended Solids) exhibit changes in response to these seasonal variations (Akbor et al., 2017). A study found out that tanneries are causing heavy metal contamination in the Buriganga river, especially Chromium (Asaduzzaman et al., 2016). Studies also revealed that Turag, a tributary of the Buriganga River, was contaminated with heavy metals (Banu et al., 2013). At Buriganga River, DO (Dissolved Oxygen) decreased (from 5.41 to 4.24 mg/L) in amount whereas BOD (Biological Oxygen Demand) increased (from2.21 to 6.82 mg/L) in the dry season (Asaduzzaman et al., 2016). The pH of the Buriganga River is high in the winter and slightly low during the rainy season (August), ranging from 6.63 to 7.35. At Buriganga river water in the winter, the average pH was 7.67±0.46 (Akbor et al., 2017).

The present study was performed for water quality analysis on the Buriganga and Dhaleswari Rivers. The project aimed to target Tannery Pollutions near Hajaribag and Harindhara, pollutions from the river vessels in and around Sadarghat Launch Terminal and Pollutions from the Dyeing Industries in Shyampur to scientifically monitor and analyse water quality in the adjacent points of the rivers. The sampling locations were selected based on their proximities to the pollutant sources. Three sample sites were chosen from Buriganga River. They are namely old tannery industries at Hazaribagh (OTI) which was chosen for tannery pollution as Hazaribagh has hundreds of tanneries located on riverbanks with effluents discharged into the Buriganga River without proper treatment. Sadarghat Spot (SS) was chosen for the pollution from the naval vessels that connects the capital with southern Bangladesh and Shyampur Dyeing Spot (SDS) for the dyeing pollution. One supplementary location was considered from the Dhaleswari River at Hemayetpur located for new tannery industry (NTI) to contrast with the Hazaribagh spot (figure 2). The tanneries are relocated from the Hazaribagh to Hemayetpur, and effluents flow to the Dhaleshwari river. Henceforth, the water samples have been collected from this site as supplementary information to contrast with the Buriganga River.

I. Hazaribagh Old Tannery Industries (OTI): Hazaribagh is one of the northern wards of Dhaka South City Corporation, once famous for the tannery industry. A few years back, the tannery industries there were mostly shifted to Hemayetpur, but there are still some factories along with the subsidiary industries associated with tanning industry. Total 155 plots were allocated to Savar while the decision of relocation took place. But over the over the course of time more than 230 tannery industries were operating while the relocation took place. Therefore, pollutants were generated from those industries and households nearby are still polluting the river at that point.

II. Sadarghat Station (SS): Sadarghat Terminal is Dhaka's central hub for water transport, connecting the southern districts via water ways. Everyday arrival and departure of numerous water vessels make the inland port one of the busiest spots in Dhaka. Various pollutants generated from vessels and houses nearby make the water polluted.

III. Shyampur Dyeing Spot (SDS): Shyampur is the spot for dyeing industries and steel rerolling mills produces significant industrial waste directly disposed to Buriganga river.

IV. Hemayetpur (Savar) New Tannery Industry (NTI): New hub for most of the tannery industries that are releasing significant amount of untreated tannery waste into Dhaleswari river.

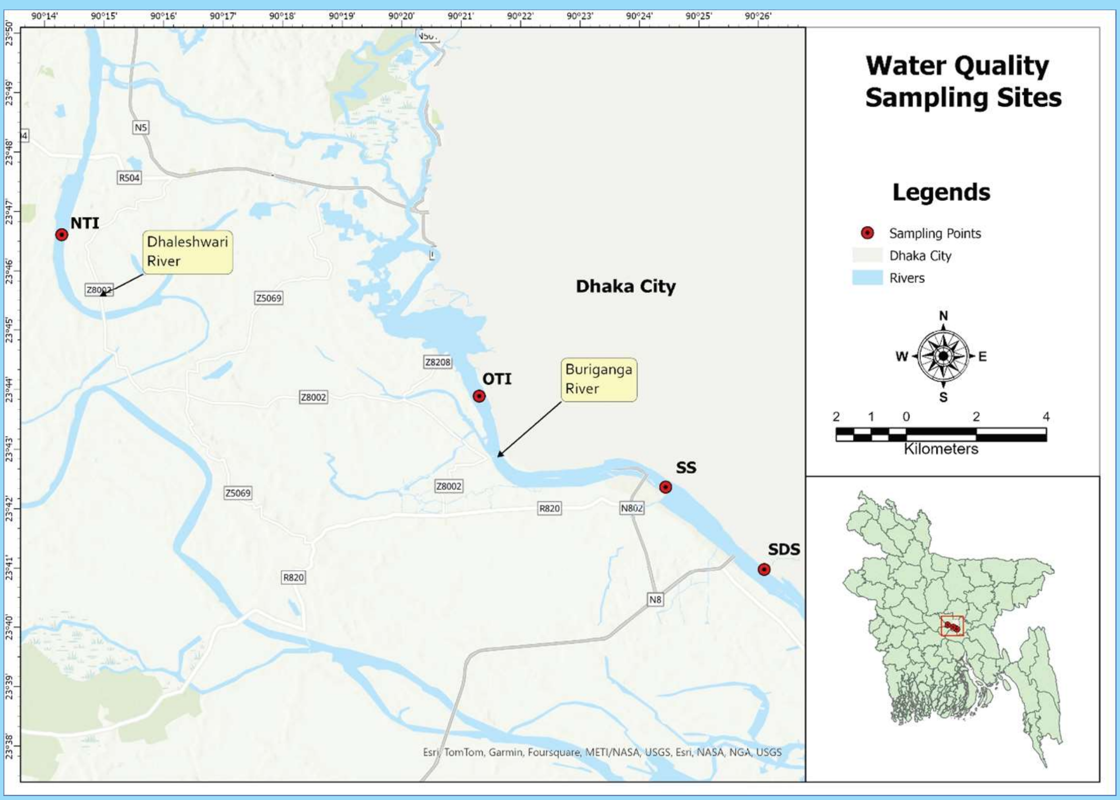


Figure 2: The river stretch studied with sampling points of the Buriganga and Dhaleswari River

2.2.2 Air and Noise Quality Analysis

Fine particles matter (PM) is recognized as the main air pollutant because of their potential impact on human health. Particulate Matter samples in three size fractions PM_1, PM_{10}, $PM_{2.5}$ were collected from April 2021 to March 2022 from 10 locations of Dhaka city (figure-3).

The Department of Environment (DoE) has categorized the Dhaka city into five forms of land use and for the purposes of noise monitoring (in Environment Conservation Rules 1997, Schedule 4), namely: 1) sensitive area, 2) residential area, 3) commercial area, 4) industrial area and 5) mixed area. Accordingly, our consortium has selected 10 locations based on these categories for noise and air monitoring. Study have collected samples for air and noise pollution at the same locations, since vehicle pollution is one of the main sources of both the pollutions in Dhaka city. Our rationale for selecting those 10 locations is given below:

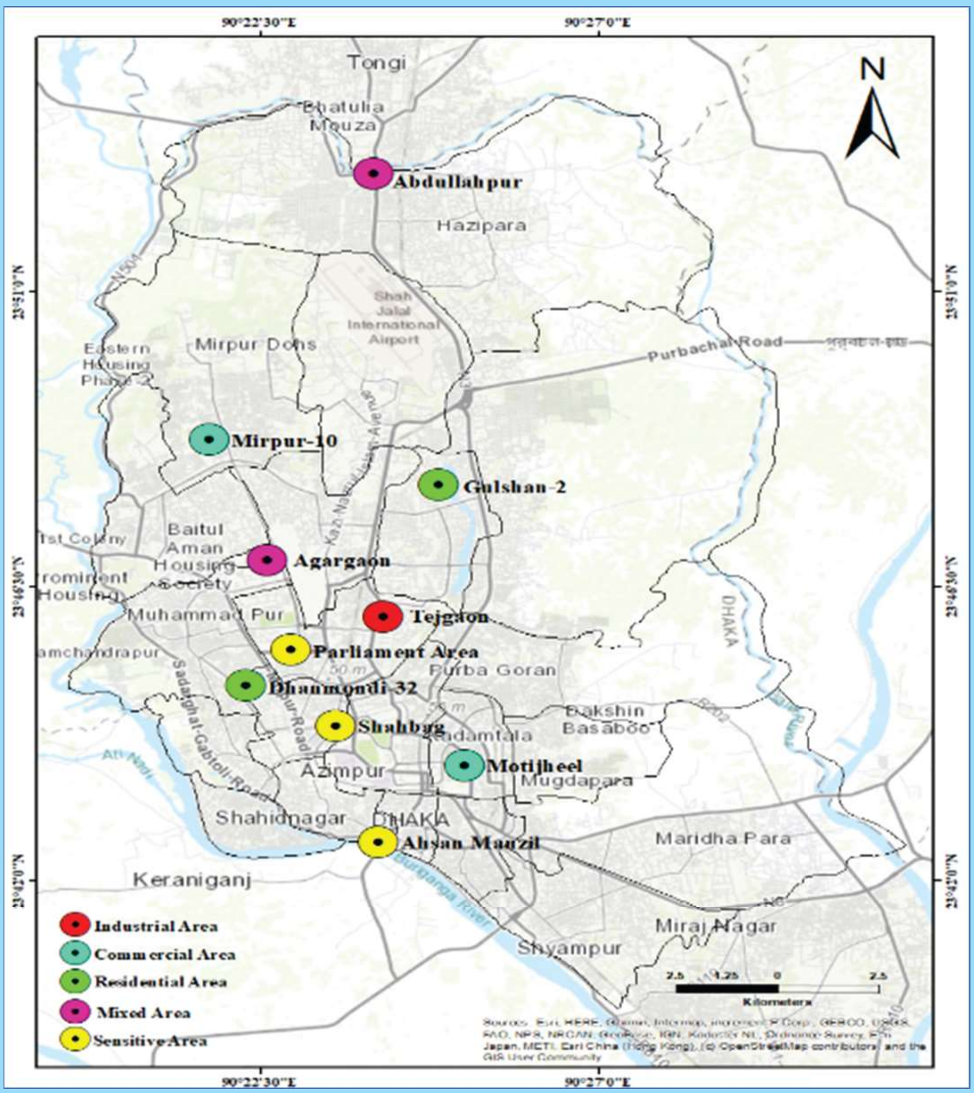


Figure 3: Location Map of Air Quality and Noise Level Data Collection at Dhaka City

I. Ahsan Manzil (Sensitive Area-1): Ahsan Manzil is a very famous historical place of Dhaka city. It is in old Dhaka by the bank of Buriganga river. This place is heavily crowded as a tourist spot and that's why children and women are more vulnerable here compared to other places in the city. The river Buriganga flows by its side. Motorized vehicle like car, bike, truck, pick-up van etc. and non-motorized vehicle like cycle, rickshaw, paddle van etc. movement has been observed here. It also carries a variety of vessels, from small diesel-powered boats to large launches and steamers.

II. Shahbagh (Sensitive Area-2): Shahbagh is also a sensitive area because there are two major hospitals- Bangabandhu Sheikh Mujib Medical University Hospital and BIRDEM General Hospital. A major portion of Dhaka University, the largest public university, National Museum and National Public Library are situated in this area. Due to the location of Shahbagh being in the center of Dhaka city, a large number of vehicles use Kazi Nazrul Islam Avenue (Shahbagh road) to reach all areas of Dhaka. Only motorized vehicle is moving beside a large part of the Metrorail mega project construction work going on over the year.

III. Mothijheel (Commercial Area-1): Mothijheel is the biggest commercial area in Dhaka city. Almost all the headquarters of the financial institutions and most of the ministries of Bangladesh are in the vicinity of Motijheel. Both motorize and non-motorized vehicle are move through the Shahbag circle.

IV. Dhanmondi-32 (Residential Area-1): Dhanmondi is one of the old and higher-class residential areas in Dhaka city. Dhanmondi is known as the central location of extended Dhaka. Bangabandhu Bhaban also known as Bangabandhu Memorial Museum that are situated here. Well known Dhanmondi 32 no. Lake Parks are also situated here so that a large number of people are visit here every day. Dhanmondi 32 Road is quite busy as it has direct connection with Mirpur Road (Main Road). Almost all types of motorized and non-motorized vehicles pass through here to enter the Dhanmondi residential area except large freight trucks and passenger buses.

V. Gulshan-2 (Residential Area-2): Gulshan is the wealthiest neighbourhood in Dhaka. Gulshan 2 is an upscale enclave with leafy streets of modern apartment buildings, embassies, and a high-end international dining scene focused on Gulshan Avenue. A well-to-do crowd congregates in stylish cafes and goods market and commercial offices on the avenue and around Gulshan Circle 2. The area was originally built with the purpose of being solely residential. Gulshan is now a mix of a serene residential area and commercial area. Motorized vehicles are dominant here, few non-motorized vehicles are allowed in sub streets.

VI. Parliament Area (Sensitive Area-3): The area of Jatiya Sangsad Bhaban or National Parliament House is a sensitive area as residence of the Prime minister and Member of Parliaments resident are located in this area. The Manik Mia Avenue is the busiest road of the area, both motorized and nonmotorized vehicle are allowed here but speed limit of vehicle strictly maintain here. The area has sufficient open space with vegetation and water body.

VII. Abdullahpur (Mixed Area-1): Abdullahpur is situated nearby to Sector 9, and close to Sector 8 of Uttara. This area is supposed to be a well-planned extension of Dhaka city.

Abdullahpur is a mixed area with commercial and industrial spaces, there are a number of private hospitals, universities and colleges. Abdullahpur bus stand is the one of busiest entrance of Dhaka city. Smallest to Large, Motorized or non-motorized all kind of vehicle are roaming here. In particular, Dhaka-bound inter-district buses and trucks from the northern part of Dhaka (Gazipur district) enter Dhaka through Abdullahpur bus stand.

VIII. Tejgaon (Industrial Area-1): This is one of the biggest industrial areas inside Dhaka city. Historically, the area has been a center of industrial activity in the city. Numerous plants and factories are in Tejgaon, in such diverse industries as garments, food processing, metal works, pharmaceuticals, etc. Tejgaon has emerged as an important business area of Dhaka. Several newspaper and television head office are situated here. Almost all types of motorized and non-motorized vehicles pass through here to enter the area except specially freight trucks area roaming here more.

IX. Agargaon (Mixed Area-2): Agargaon area that hosts all these aforementioned important classes of area along with many important government institutions, offices, ministries, hospitals, school, collage, Bank, etc. The area is also a fantastic residential neighbourhood, hosting various government quarters, offices, and private residences. Almost all types of motorized and non-motorized vehicles pass through Begum Rokeya Sarani and Syed Mahbub Morshed Road.

X. Mirpur-10 (Commercial Area-2): Mirpur-10 is an avenue with four roads connecting it to the major suburbs of Dhaka meaning it is densely packed with several govt. offices with residential and commercial settlements. There are also few garment factories in these suburbs. One of the international cricket venue and national zoo are in its vicinity. Almost all types of motorized and non-motorized vehicles pass through Begum Rokeya Sarani and Mirpur Road.

2.2.3 Community Perception Analysis

To collect community perceptions regarding the impact and significance of pollution and obtain recommendations for mitigation, WKB Consortium organized nine Community meetings and nine river talkies. Within this two years project, WKB Consortium organized this event in different places in Dhaka city. The areas covered by this event were Bosila, Kamrangirchar, Nawabganj Park (Lalbagh), Kayatpara Bazar (Balurpar, Khilgaon), City Daffodil School (Trimohoni, Khilgaon), Uttara Govt Primary School (Moricharteck, Aminbazar), Trimohini Bazar (Trimohoni, Khilgaon) and Aminbazar Landing Station Ghat (Aminbazar).

2.2.4 Policy and Legislative Framework Analysis

The project conducted two separate studies on analysis of legislative landscape and analysis of court orders through commissioning of consultants to integrate into this report. Executive summaries of these report have been inserted in this SoDE report.

2.3 Data Collection

Both primary and secondary data are collected for the study by deploying qualitative and quantitative tools and techniques. Broadly, this study combines three significant data catchments sources: laboratory data, people's voice, and legal perspectives to connect the data for a meaningful understanding for policymakers (figure 4). The water, air and noise data were obtained through direct field sample collection. Analytical data were obtained from laboratory tests conducted by Intertek (Annex-A) for water parameters and CAPS (Annex B) for air and noise parameters.

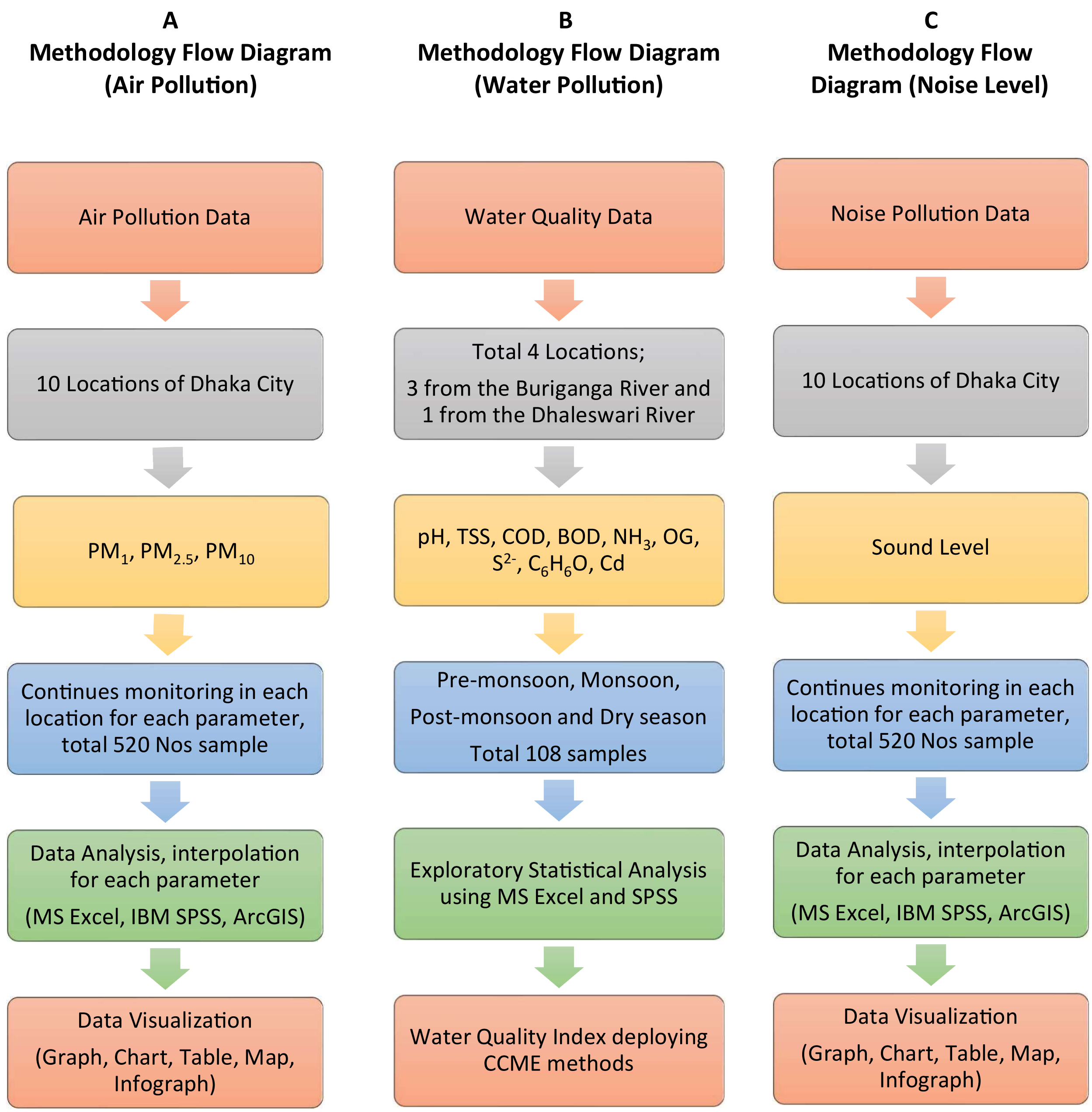


Figure 4: Methodology Flow Diagram of Air, Water & Noise

Different approaches based on methods and objectives has been taken for the data collection of different aspects of the study, which has been described below:

2.3.1 Water Quality Data

WKB consortium started water quality monitoring in the river Buriganga and Dhaleshwari (figure 5). Water quality sample data were collected in eight rounds during 2021 and 2022. Following was the schedule for water quality data collection (Table 1).

Figure 5: Water Quality Sample Collection at Sadarghat

Table 1: Water Quality Data Collection Date

Seasons	Date	Sample Collection Points
Pre-Monsoon	27th May, 2021	Hemayetpur and Hazaribagh
	28th May, 2021	Sadarghat and Shyampur
Monsoon	14th July, 2021	Hemayetpur and Hazaribagh
	15th July, 2021	Sadarghat and Shyampur
Post-Monsoon	11th October, 2021	Hemayetpur and Hazaribagh
	12th October, 2021	Sadarghat and Shyampur
Dry	12th January, 2022	Hemayetpur and Hazaribagh
	13th January, 2022	Sadarghat and Shyampur
Pre-Monsoon	11th April, 2022	Hemayetpur and Hazaribagh
	12th April, 2022	Sadarghat and Shyampur
Monsoon	18th July, 2022	Hemayetpur and Hazaribagh
	19th July, 2022	Sadarghat and Shyampur
Post-Monsoon	8th November, 2022	Hemayetpur and Hazaribagh
	9th November, 2022	Sadarghat and Shyampur
Dry	6th December, 2022	Hemayetpur and Hazaribagh
	7th December, 2022	Sadarghat and Shyampur

2.3.2 Air Quality Data

The instrument used for this study was Aeroqual portable monitors, S500 (figure 6). The Series 500 air quality sensor enables accurate real-time surveying of common outdoor air pollutants, all in an ultra-portable hand-held monitor. Air quality professionals typically use the Series 500 for short term air quality studies and carrying out checks on pollution "hot spots". Data is stored on board the Series 500 with a max 8,188 records available. To download the data a USB cable is needed for connection to PC. Software provided with the Series 500 takes the data on PC and presents it in a chart or table view. Data can be downloaded and viewed in Excel. Other features on the Series 500 include monitor ID and location ID. Monitor ID identifies the monitor uniquely and ensures that all data from it are tied to that monitor. Location ID can be used to tag measurements to a specific location which is helpful when sampling at a number of sites over the course of a day or week.

Figure 6: Air Quality Monitoring Device

General Specification of Air Quality Monitor

- Model: S500
- Range: 0.000 to 1.000 mg /m^3
- Measurement Parameters: Particulate matter
- Sensor Type: Laser particle counter
- Min Detection Limit: 0.001 mg/ m^3
- Accuracy of Factory Calibration: ± (0.002 mg/ m^3+ 15 % of reading)
- Resolution: 0.001 m^3
- Response Time: 5 Seconds
- Temp: 0 to 40°C
  Relative Humidity: 0 to 90% non-condensing.

2.3.3 Noise Level Data

This SD series sound level meter has triple range measurement and features user selectable sampling rates from 1 to 3600 seconds (figure 7). A user can select a desired sampling rate and quickly generate an Excel file with raw data using an SD card (up to 16 Gb), all without the use of software. Optional accessories include a tripod and AC adapter for continuous long-term monitoring and PC software that allows a user to tracking live measurements.

Figure 7: Noise Level Meter

General Specifications Sound Level Meter

- Model: SL-4023SD
- Real time data recorder, save the data into the SD memory card and can be download to the Excel, extra software is no need.
- Meet IEC61672 class 2
- Auto range: 30 to 130 dB.
- Manual range: 3 ranges 30 to 80 dB, 50 to 100 dB, 80 to 130 dB.
- A/C frequency weighting.
- Fast/slow time weighting,
- Peak hold, Data hold.
- Record (Max., Min.).
- RS232/USB computer interface.
- Optional wind shield ball, SB-01.
- Patent: Taiwan, China, Japan, Germany, USA pending.

2.3.4 Civil Society and Community Perception Data

CS and Community Perception Data has been collected through conversation analysis and dialogues in the form of river talkies and community meetings. The goal of gathering data for conversation analysis is to document interactional activities as they take place in their natural environments so that corporation may be built over time and analysed and reanalysed in light of new and existing information.

2.3.5 Policy and Legislative Framework Data

Separate studies have been conducted through commissioning of two consultants to analyse legislative landscape and implementation gap, and to analyse of court orders.

2.4 Data Analysis

The following section will describe different data analysis method of the study.

2.4.1 Water Quality Data

The exploratory statistical techniques were deployed to analyse the water parameters, and then the water quality index was formulated using the CCME WQI approach. CCME WQI, which stands for The Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI), was developed as an efficient way to summarise complex data. Published in 2001, it contains the guideline for assessing the water quality of any area of the water resources. Since the water quality index inception, numerous water quality index methods have been developed and deployed to assess the water quality in different riverine environments.

These are:

I. Weighted arithmetic index method (Brown et al., 1972)
II. The Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) in 2001.
III. National Sanitation Foundation Water Quality Index (NSF WQI)
IV. Nemerow's Pollution Index (NPI)

2.4.1.1 Conceptual Framework of CCME WQI

The CCME WQI methods offer multidimensional factors of seasonal and spatial variability of the water quality. Thus, it is used to classify the water class and status of the river compared to other methods. The CCME technique includes organic and inorganic water parameters to calculate the water quality index (WQI) through spatial and temporal contexts. Therefore, like any other water quality index method, the steps of CCME QWI transform the analytical water quality data shown in figure-8 as a flow chart:

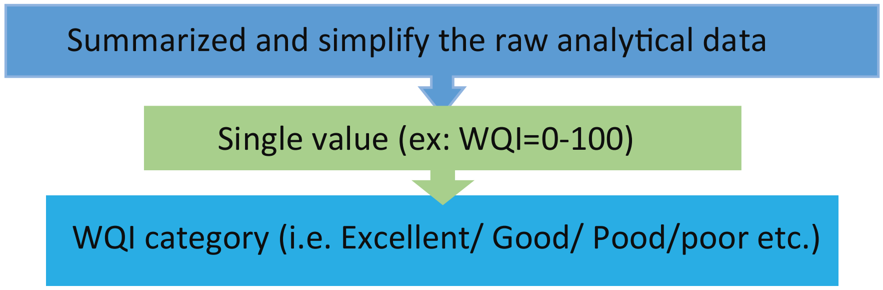


Figure 8: Basic steps of CCME WQI Calculation

The following steps and procedures are required for obtaining the water quality index of any study of the open water bodies. CCME WQI consists of three main elements (F1, F2 and F3):

a. F1 (Scope)
b. F2 (Frequency) and
c. F3 (Amplitude)

2.4.1.2 Formula and Step for calculating CCME WQI:

STEP-1: Calculating the scope value (F1 value)

$$F1 = \frac{Number\ of\ Failed\ Variables}{Total\ Number\ of\ Variables} \times 100$$

STEP-2: Calculating the Frequency value (F2 value)

$$F2 = \frac{Number\ of\ Failed\ Test}{Total\ Number\ of\ Test} \times 100$$

STEP-3: Calculating the Amplitude value (F3 value)
This step follows three sub steps:

STEP-3.1: When the test value must not exceed the objective:

$$excursion_i = \frac{Failed\ Test\ Value}{Objective_i} - 1$$

For the cases in which the test value must not fall below the objective:

$$excursion_i = \frac{Objective_i}{Failed\ test\ value_i} - 1$$

STEP-3.2: Normalised sum excursion value (nse)

$$nse = \frac{\sum_{i=1}^{n} excursion_i}{Total\ number\ of\ tests}$$

STEP-3.3: Amplitude value (F3 value) using normalized sum excursion value (nse)

$$F3 = \frac{nse}{0.01 nse + 0.01}$$

Finally, the following formulation produces a value between 0 and 100 and gives a numerical value to the state of water quality.

$$CCME\ WQI = 100 - \left[\frac{\sqrt{F1^2 + F2^2 + F3^2}}{1.732}\right]$$

Note that a zero (0) value signifies very poor water quality, whereas a value close to 100 signifies excellent. The assignment of CCME WQI values to different categories is a somewhat subjective due to the variability of pollutants sources that demand expert judgment to meet the public's expectations of better water quality.

The water quality is ranked in the following five categories:

1) Excellent: (CCME WQI values 95–100)
2) Good: (CCME WQI values 80–94)
3) Fair: (CCME WQI values 60–79)
4) Marginal: (CCME WQI values 45–59)
5) Poor: (CCME WQI values 0–44)

Data were derived from field investigation and laboratory, computed in CCME WQIs for the four pre-monsoon and monsoon season sampling sites in Buriganga and Dhaleswari River. All the data related to water parameters were analysed to find out the calculated value to compare with the water quality index (WQI) to assess the river status precisely. The linear statistical standardised techniques were applied to assess the air and noise quality of the sampling sites.

2.4.2 Air Quality Data

Aeroqual monitors were placed tripod at ~1.5 m elevation above the ground. The monitors were positioned horizontally. The monitoring location was nearest to road with no other primary pollutant sources nearby. The Aeroqual monitors were programmed to record 1-min average concentrations of particulate matter continuously. To turn the monitor on: press and hold the power button until the screen activates. Prior to operation the sensor must be warmed up to burn off any contaminants. When the monitor is first switched on it warm up for 3 minutes. At the same time surveyor set the location ID for each location. Monitors collect and store air quality data automatically after warming up. The data downloading is very simple, because the device can be connected to a PC directly with a USB cable: a PC software is available to download/export the data, which can then be exported then to an Excel format. A total of 8 hours of data has been collected daily for 4 hours at each survey site. Where Each site 240-unit of air quality data captured. Year-round total target was to collect 520 nos. of data over 10 locations. So finally, 1,24,800-unit data (One Lac Twenty-four Thousand Eight Hundred) has been collected. Data Analysis has been done using MS Excel 2021, IBM SPSS v.26, interpolation map has been producing by using ArcGIS v.10.7. Several graph and chart have been producing for better understand of summarized data. To convert from $PM_{2.5}$ concentration to AQI this equation is used.

$$I = \frac{I_{high} - I_{low}}{C_{high} - C_{low}} \square (C - C_{low}) + I_{low}$$

Where,
I: the (Air Quality) index
C: the pollutant concentration
C_{low}: the concentration breakpoint that is ≤ C
C_{high}: the concentration breakpoint that is ≥ C
I_{low}: the index breakpoint corresponding to C_{low}
I_{high}: the index breakpoint corresponding to C_{high}
C_{low}, C_{high}, I_{low}, I_{high} are from the US EPA Pollutant Breakpoint

2.4.3 Noise Quality Data

The data record function records the max and min readings. Press the REC Button once to start the Data Record function and a "REC" symbol will appear on the display. With the "REC" symbol on the display:

1) Press the REC Button once, and "REC. MAX." symbol along with the max value will appear on the display. To delete the max value, press the Hold Button once and the display will show a "REC." symbol only and execute the memory function continuously.
2) Press the REC Button again, and a "REC. MIN." symbol along with the min value will appear on the display. To delete the min value, press the Hold Button once, and the display will show a "REC." symbol only and execute the memory function continuously.
3) To exit the memory record function, press the REC button for 2 seconds. The display will revert to the current reading.

The data was collected above ~1.5 meter of the ground and the data was taken by standing on the roadside. Any kind of noise barriers was avoided for measuring the actual sound level. Every second data was taken for the sampling and total sampling time for each station. Recorded data were stored in MicroSD card (memory card). A total of 8 hours of data has been collected daily for 4 hours at each survey site. Where Each site 240-unit of air quality data captured. Year-round total target was to collect 520 nos. of data over 10 locations. So finally, 37,44,000-unit data (Thirty-Seven Lac Forty-four Thousand) data has been collected. Data Analysis has been done using MS Excel 2021, IBM SPSS v.26, interpolation map has been producing by using ArcGIS v.10.7. Several graph and chart have been producing for better understand of summarized data. The time-varying sound is usually described statistically, either in terms of LAeq, the equivalent continuous sound pressure level for a given period, or in terms of Ln, the sound pressure level which is exceeded for n % of the time. Both LAeq and Ln are expressed in dB(A) unit. The data collected were calculated by using Equation for LAeq.

$$L_{Aeq} = 10 \ log \sum_{i=t}^{i=n} (10)^{Li/10} (t_i)$$

n = the total number of samples taken
L_i = the noise level in dB(A) of the i^{th} sample
t_i = fraction of total sample time.

L_{max}, L_{min}, L_{10}, L_{50} and L_{90} were also calculated. L_{Max} is the highest value measured by the sound level meter over a given period (L_{max}). L_{Min} is the lowest value measured by the sound level meter over a given period (L_{min}). L_{10} is the sound level at 10% of the measurement period and is often used to give an indication of the upper limit of a range of sounds, such as that from road traffic. The L_{50} is a statistical descriptor of the sound level exceeded for 50% of the time of the measurement period (t). The value of L_{90} is the noise level at 90% of the measurement period and is often taken as "background" or "ambient" noise level. L_{10}, L_{50} and L_{90} were calculated by the following steps in Microsoft Office Excel Spreadsheet® 2021:

I. Type [= PERCENTILE (array,k)]
II. Select the array from noise data
III. Put k = 0.9 to calculate L10
k = 0.5 for L50
k = 0.1 for L90
IV. Enter

2.4.4 Civil Society and Community Perception Data

One such technique for analysing qualitative data is conversation analysis. Its fundamental goal is to define and clarify how conversational contact maintains an interactional social order by looking at the "technology of conversation" (Bloor and Wood, 2006). The conversation between the CS and the community people in the meetings and river talkies has been recorded and then analysed considering the research objective and project goal.

2.4.5 Policy and Legislative Data

Policy and Legislative Analysis follows Exploratory Literature Review method, which gives the reader—or the intended audience—a foundation of the theory, as well as a review of published works that are relevant to the researcher's inquiry and a more in-depth critique of that work. Firstly, the names of policies and legal documents has been identified from the earlier literature review section. Then another literature search has been conducted by those names. Finally, those documents have been read thoroughly and analysed in a critical lens. Two separate studies on legislative analysis and court orders were conducted to feed into the SoDE report.

CHAPTER THREE: STATE OF WATER, AIR AND NOISE QUALITY

Previous chapter (chapter 2) briefly described the use of data and methodology. This chapter presents the results of the analysis of scientific data. This section details the water, air and noise quality assessment based on the data acquired within the project period. The water quality, air quality and noise quality of Dhaka city has been described in three different sections.

3.1 State of Water Quality

The State of Environment's complete report includes the water quality assessment covering four seasons: pre-monsoon, monsoon, post-monsoon and dry for 2021 and 2022 at four sampling sites of the Buriganga and Dhaleswari River in the form of spatial and temporal analysis. In the following flowchart (figure 9), an overall revision of the study of water quality workflow has been presented.

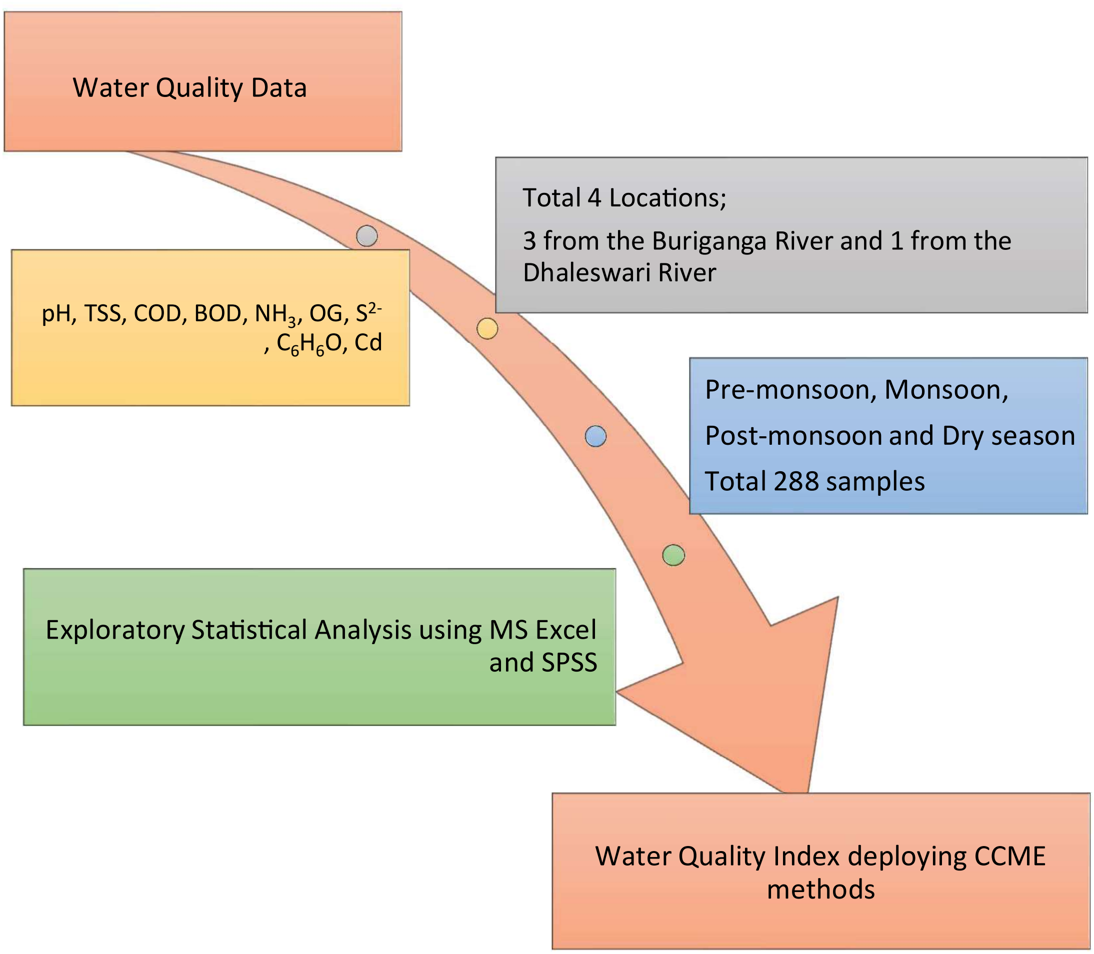


Figure 9: Workflow of water quality analysis

In the following sub-sections, temporal and seasonal water quality variations have been illustrated with necessary diagrams.

3.1.1 Spatial and Temporal Dynamics of the PH of 2021

If the pH level is seven in water, it is considered neutral. Higher than seven means the water is acidic, and lower than seven is considered alkalic. Only Hazaribagh station showed the water level as neutral almost all the year. However, in the Sadarghat station, the result is high, with 7.6 in the pre-monsoon, 7.4 in the monsoon, 7.3 in the post-monsoon period, 7.4 in the dry season with an average of 7.43. The water of Shyampur showed some alkalic characteristics in the monsoon and acidic characteristics in the pre-monsoon. The pH level of Shyampur in the dry season is 5.6, which is the lowest and can be considered alkalic. All the stations can be considered an expected result because the global pH level is 6.5 to 7.5 (figure-10). Although stiffer limitations are frequently set, higher pH tolerance is exhibited because carbon dioxide from the environment or biological processes in healthy surface water systems tends to decrease pH levels to neutral conditions. Sensitive fish and plant life are vulnerable to lose if the pH of surface water fluctuates too far either way from the pH range of 6.5 - 7.5.

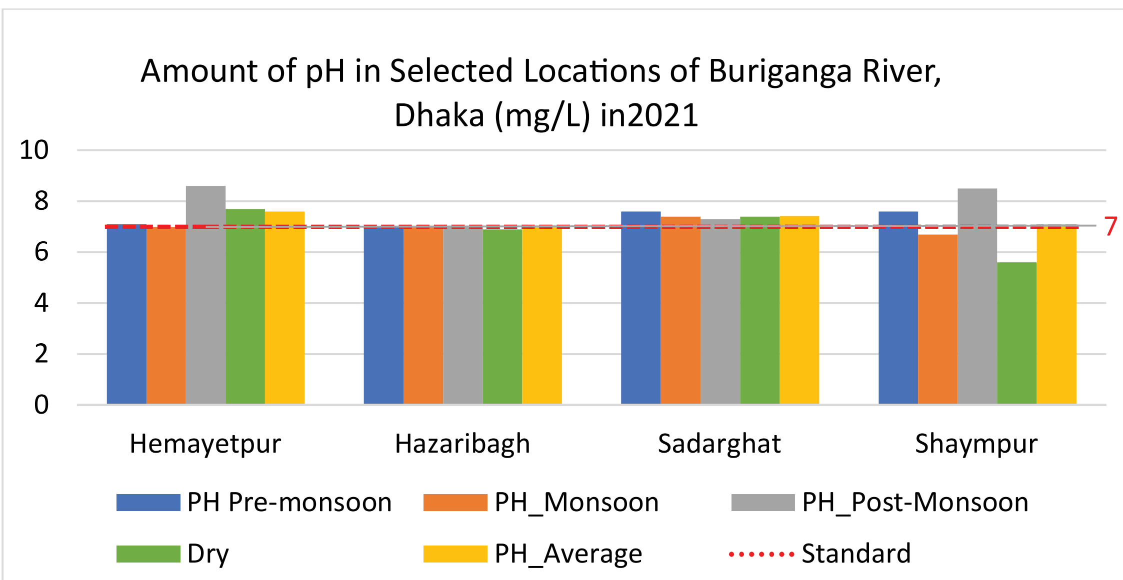


Figure 10: The average variation of the pH at the study sites in 2021

3.1.2 Spatial and Temporal Dynamics of the TSS in 2021

TSS or total suspended solids refers to the particles of more than 2 microns contaminated in the water – this could be sand, sediments and plankton, affecting water clarity. The standard level of TSS is ten mg/L; however, the lesser the value, the more apparent it will be. All the stations show very high TSS level, especially in the post-monsoon period. In the monsoon period, Sadarghat only matched the standard and had the lowest value in the pre-monsoon. Hazaribagh has the highest value in the pre-monsoon, Shyampur has the highest in the monsoon, and Hemayetpur has the highest in post-monsoon. Hemayetpur has the highest average TSS value, whereas Shyampur and Hazaribagh also experience high TSS values. Sadarghat has the lowest in both seasons, resulting in a low average value all along the year. Hazaribagh showed a relatively high level of TSS in the dry period, Shyampur also showed a relatively high TSS level in the dry seasons (figure-11).

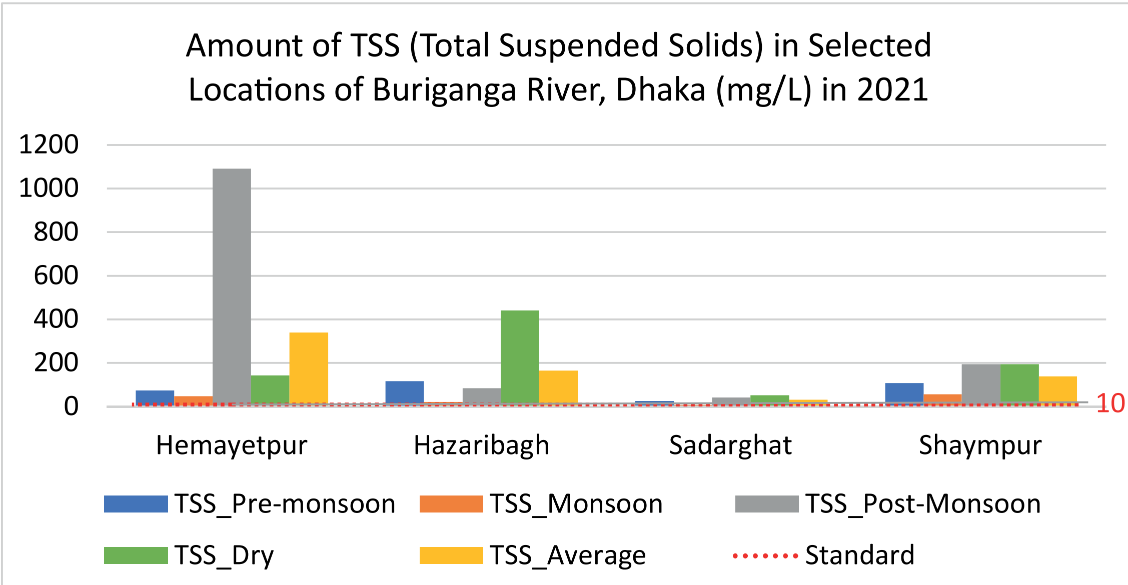


Figure 11: Amount of TSS (Total Suspended Solids) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

The quantity of insoluble matter in wastewater is described as the suspended solids component of an effluent. When these insoluble materials are discharged from a site, they generate a range of issues; they are made up of solids with two distinct features. When an affluent sample is agitated, material in suspension is visible, but the material settles when the sample is permitted to stand. Although most of these particles settle in 5 to 10 minutes, specific fine granules can take up to an hour to settle. Fine leather particles, leftovers from various chemical discharges, and reagents from various waste liquors make up these solids from all stages of leather production. During beam house procedures, large volumes are produced. Even a thin layer of settled muck can form a blanket that obliterates oxygen from the river or lakebed areas. Decomposition begins when plant and marine life die. Semi-colloidal solids are very fine solids that will not settle out of an effluent sample for all intents and purposes, even if permitted to stand for a long time. However, they can be filtered out of solutions. They make up the suspended solids of an effluent that may be measured analytically, together with the more easily settleable solids. The majority of these solids are protein residues from beam house operations, primarily liming activities; however, considerable numbers are also created due to poor uptake in vegetable tanning processes, with poor uptake during retaining being another source. Semi-colloidal substances do not directly cause sludge. They can be broken down for a long time by bacterial digestion, resulting in solids that will finally settle.

3.1.3 Spatial and Temporal Dynamics of the Oxygen Level in 2021

Bacterial action breaks down several components in effluents into simpler components. Both the survival of these bacteria (aerobic bacteria) and the breakdown of the components require oxygen. This breakdown might happen quickly or take a long period, depending on their composition. When high-oxygen-demand effluent is discharged directly into surface water, the delicate equilibrium that exists in the water is overburdened. When oxygen is depleted in the water, oxygen-dependent plants, microorganisms, fish, and even the river or stream itself perish. As a result, an environment occupied by non-oxygen dependent (anaerobic) bacteria emerges, resulting in hazardous water.

3.1.4 Chemical Oxygen Demands (COD) Levels

Chemical Oxygen Demand is the amount of dissolved oxygen present in water to oxidise a chemical, organic materials like petroleum. High levels of wastewater COD indicate concentrations of organics that can deplete dissolved oxygen in the water, leading to adverse environmental and regulatory consequences. Oxygen demand is an essential measurement to help determine the impact and ultimately limit the amount of organic pollution in water. With extensive industrial activities, especially tannery, the Hemayetpur and Hazaribagh stations show a very high average COD level, whereas Sadarghat shows a relatively low average COD level. Shyampur has a relatively lower average COD compared to Hazaribagh and Hemayetpur but higher than Sadarghat. Shyampur has high COD in the monsoon than Hazaribagh and Sadarghat (figure-12). However, Hemayetpur has the highest monsoon and post-monsoon COD. In pre-monsoon, Hazaribagh has the highest COD. Hazaribagh also shows a higher COD level in the dry season.

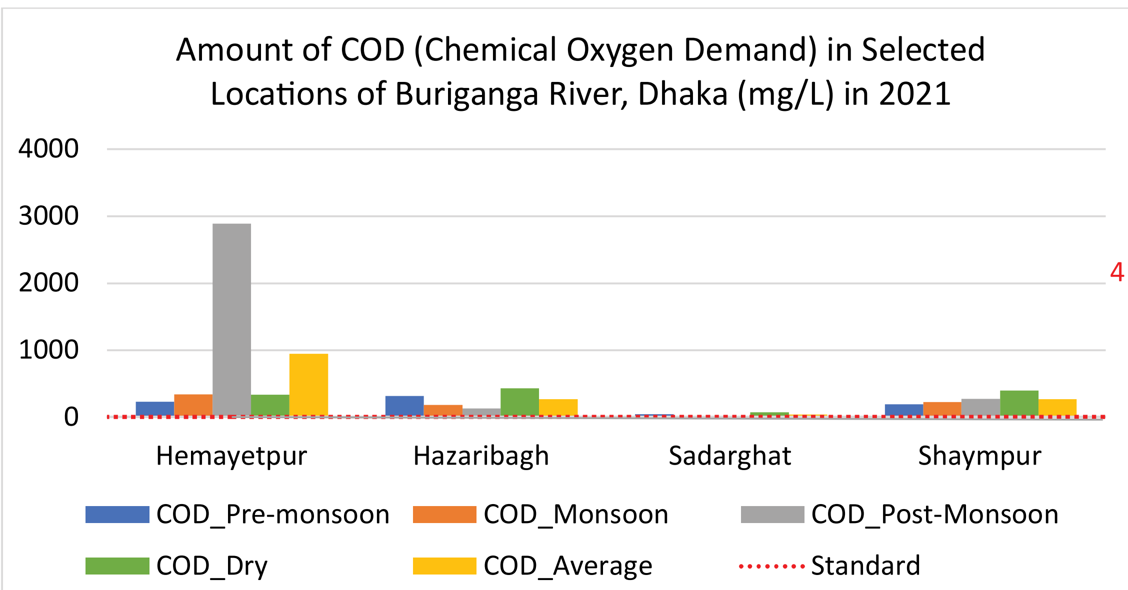


Figure 12: Number of COD (Chemical Oxygen Demand) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.5 Biological Oxygen Demand (BOD) Levels

Biological Oxygen Demand, abbreviated as BOD, represented the oxygen consumption rate of bacteria and other microorganisms. When sewage wastewater are discharged into the environment, they can start pollution in organic content to receiving water. High organics can deplete dissolved oxygen levels in the water, leading to adverse environmental and regulatory consequences. Every station has a very high level of BOD, with Hemayetpur as the highest. Shyampur and Hazaribagh also has a very high BOD but less than Hemayetpur. Sadarghat is the lowest. Every station faces the lowest BOD in pre-monsoon (figure-13). Hemayetpur, Shyampur faces the highest in the post-monsoon and Hazaribagh in the pre-monsoon. In dry season, Shyampur shows the highest BOD level with Hazaribagh in second.

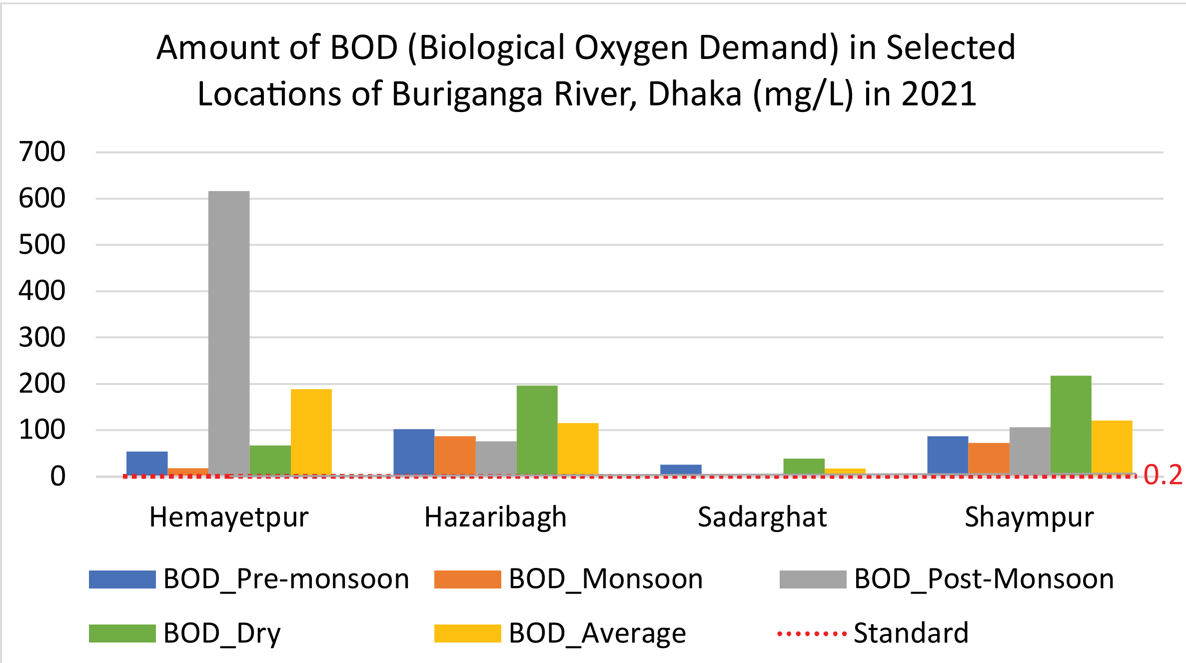


Figure 13: Amount of BOD (Biological Oxygen Demand) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.6 Spatial and Temporal Dynamics of the Ammonia in 2021

Ammonia, a form of nitrogen that exists in the aquatic environment causing direct toxic effects on aquatic life. Ammonia can enter the aquatic environment via straight means such as municipal effluent discharges and the emission of nitrogenous wastes from animals, and indirect means such as nitrogen fixation, air deposition, and runoff from agricultural lands. Hemayetpur has the highest level of Ammonia, whereas Hazaribagh has the lowest Ammonia. Every station has relatively high Ammonia in pre-monsoon. Hazaribagh has the highest ammonia contamination in the dry season. In tannery effluent, nitrogen can be found in a variety of forms. These sources must sometimes be distinguished. The chemical structure of several components in tannery effluent includes nitrogen. Ammonia (from deliming materials) and nitrogen from proteinaceous materials (from liming/unhairing procedures) are the most common compounds. These nitrogen sources provide two distinct issues. Firstly, Plants require nitrogen to thrive, but the high levels released by nitrogen-containing compounds encourage growth too much. Water-based plants and algae grow at an excessive rate, clogging rivers and impairing flow (figure-14). An abnormally large number of organic materials must be broken down as the plants die. Plants, fish, and aerobic microbes perish when the load exceeds the river's natural supply of oxygen, and anaerobic conditions arise. Secondly, Ammonia is the type of nitrogen generated during protein breakdown during the deliming process. Bacteria can convert the latter into water and nitrogen gas, which is then released into the atmosphere in multiple steps. Both of these breakdown products are non-toxic, although the process requires a lot of oxygen. Toxic anaerobic conditions can quickly occur if oxygen demand exceeds the level supplied naturally by the water channel.

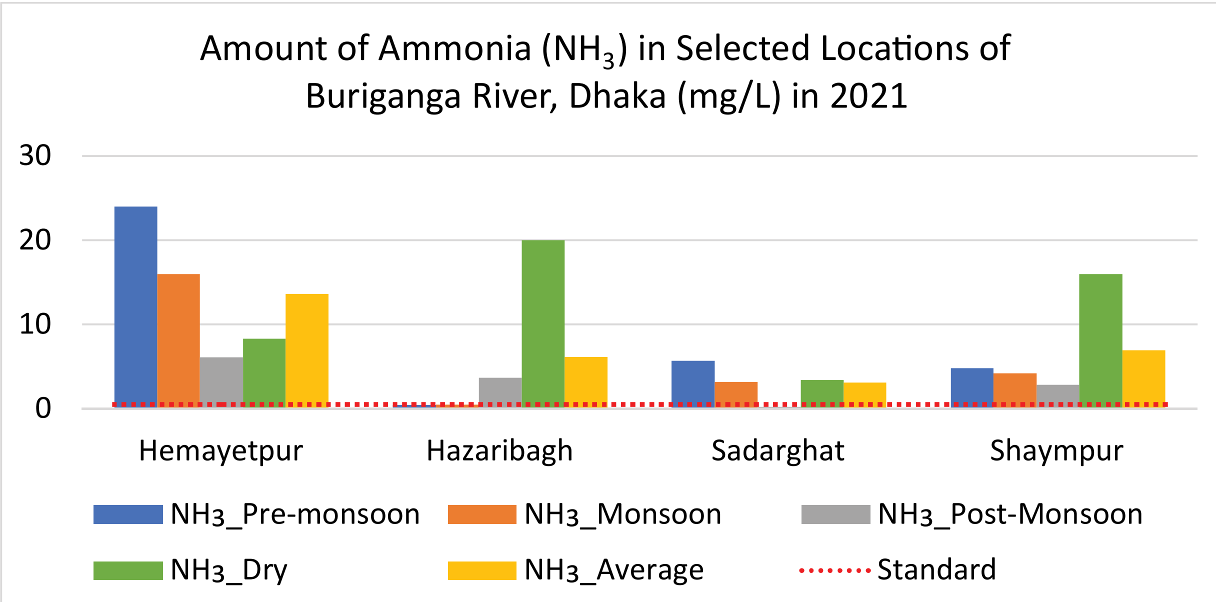


Figure 14: Amount of Ammonia (NH3) in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.7 Spatial and Temporal Dynamics of the Oil and Grease in 2021

Oil and grease (O&G) contamination are harmful to aquatic ecology, plants and mutagenic and carcinogenic for the human being. O&G decreases the dissolved oxygen rate and creates a different layer in the water, which interrupts the biological activities in the water. All the stations have the highest level of oil and grease in post-monsoon. In pre-monsoon Hazaribagh faces the highest level of oil and grease. Shyampur stands highest in the monsoon period. Natural oils and grease are liberated from the skin structure during leather production. When waste waters mix, some fatty compounds may be formed because of inter-reaction if fat liquor depletion is low. Floating grease and fatty particles clump together to form ‘mats,' which bind other materials, potentially posing a blocking problem, particularly in effluent treatment systems (figure-15). Oxygen transport from the atmosphere is inhibited when surface waters are contaminated with grease or thin coatings of oil. Because of their biodegradability, when these fatty compounds emulgate, they create a very high oxygen demand. The presence of oils and grease is detected by shaking an appropriate solvent into a layer on top of the effluent sample and allowing the solvent to separate into a layer on top of the effluent sample. This solvent dissolve fatty materials, and a small amount can be taken off and dried. It is possible to weigh and determine the leftover grease.

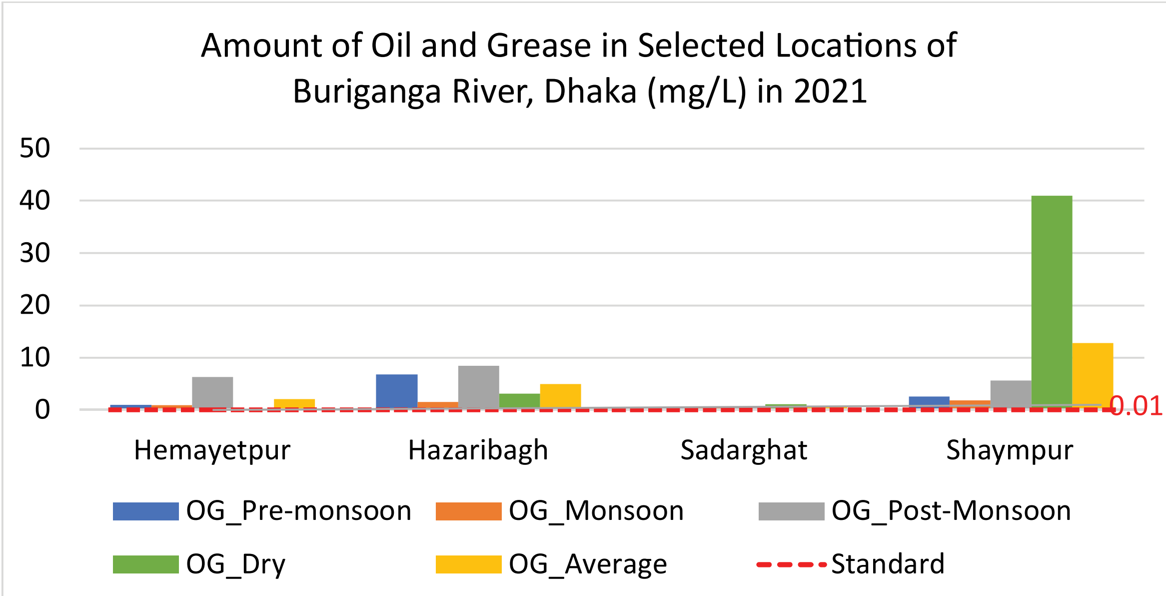


Figure 15: Amount of Oil and Grease in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.8 Spatial and Temporal Dynamics of the Sulphides in 2021

High Sulphate levels (>250 mg/L) may make the water taste bitter. High sulphate levels may also disintegrate plumbing, particularly copper piping. In parts with high sulphate levels, plumbing materials more resistant to weathering, such as plastic pipes, are usually used. In terms of Sulphides, Shyampur has shown the highest level in monsoon, pre-monsoon and post-monsoon (figure-16). Other stations show a moderately high sulphides level, with Hemayetpur in the second highest, Hazaribagh in the third. Though Hemayetpur, Hazaribagh and Sadarghat show an increased rate of Sulphides in pre-monsoon, Shyampur has a very high Sulphide's level in the monsoon period. People who are not used to with high sulphate can get diarrhoea and dehydration from drinking the water. Wildlife is also sensitive to high levels of sulphate. Among young animals, high levels may be related with severe, chronic diarrhoea and even death. The use of sodium sulphide and sodium hydrosulphide, as well as the breakdown of hair in the unhairing process, contribute to the sulphide level in tannery effluent. The sulphides cause a slew of issues: Sulphides are mostly in solution in alkaline environments. When the pH of the effluent falls below 9.5, hydrogen sulphide evolves from the effluent at a faster pace, the lower the pH, the faster the evolution. A significant stench problem emerges, which smells like rotten eggs. Even modest levels of exposure to the gas, which is similar in toxicity to hydrogen cyanide, cause headaches and nausea, as well as possible eye damage. At greater concentrations, mortality can occur quickly, and countless deaths have been linked to sulphide build-up in sewage systems. The gas hydrogen sulphide is also rather soluble. Weak acids can develop and cause corrosion when ingested. Metal roofing, girders, and building supports are all weakened because of this. Metal fittings, structural reinforcements, and pipes can rust in sewers, causing serious issues. Even modest quantities offer toxicological risks when dumped to surface water. Certain bacteria in rivers may oxidise sulphides into non-toxic chemicals, but this increases oxygen demand, which can kill aquatic life if it is too high.

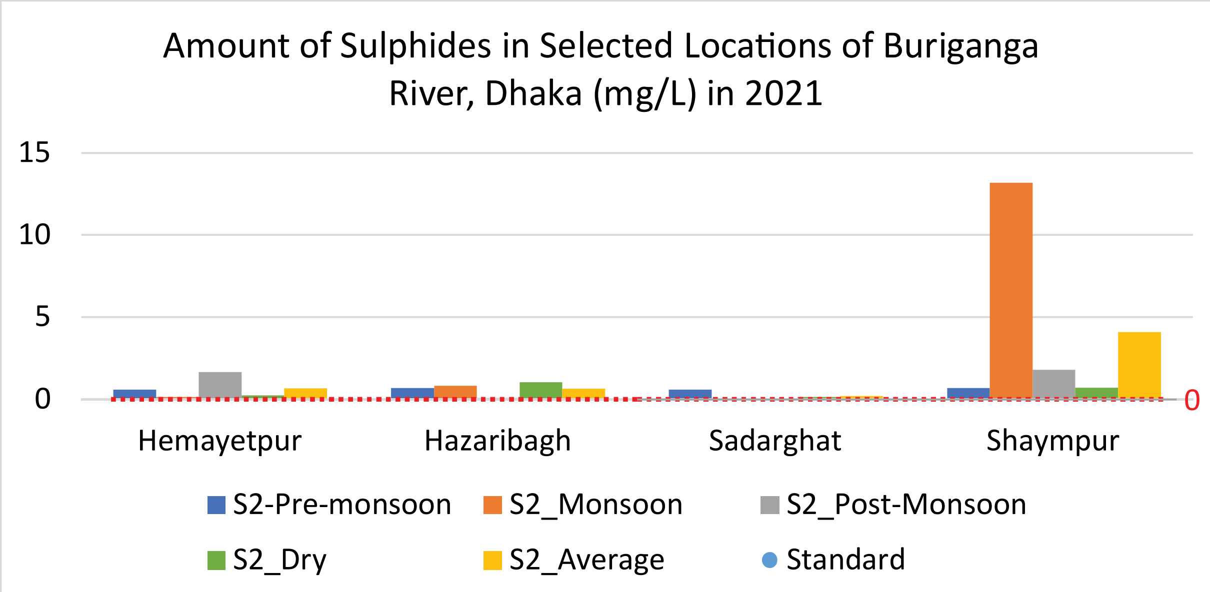


Figure 16: The amount of Sulphides in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.9 Spatial and Temporal Dynamics of the Phenols in 2021

Every station shows a very high result in Phenol, with Hemayetpur having the highest and Hazaribagh having the lowest average. Three stations experience an increasing Phenol rate in monsoon. However, only Sadarghat shows a high Phenol activity in pre-monsoon (figure-17). Phenol, a waste product of industrial processes introduced into aquatic ecosystems, adversely affects the indigenous biota, including algae, protozoa, invertebrates, and vertebrates.

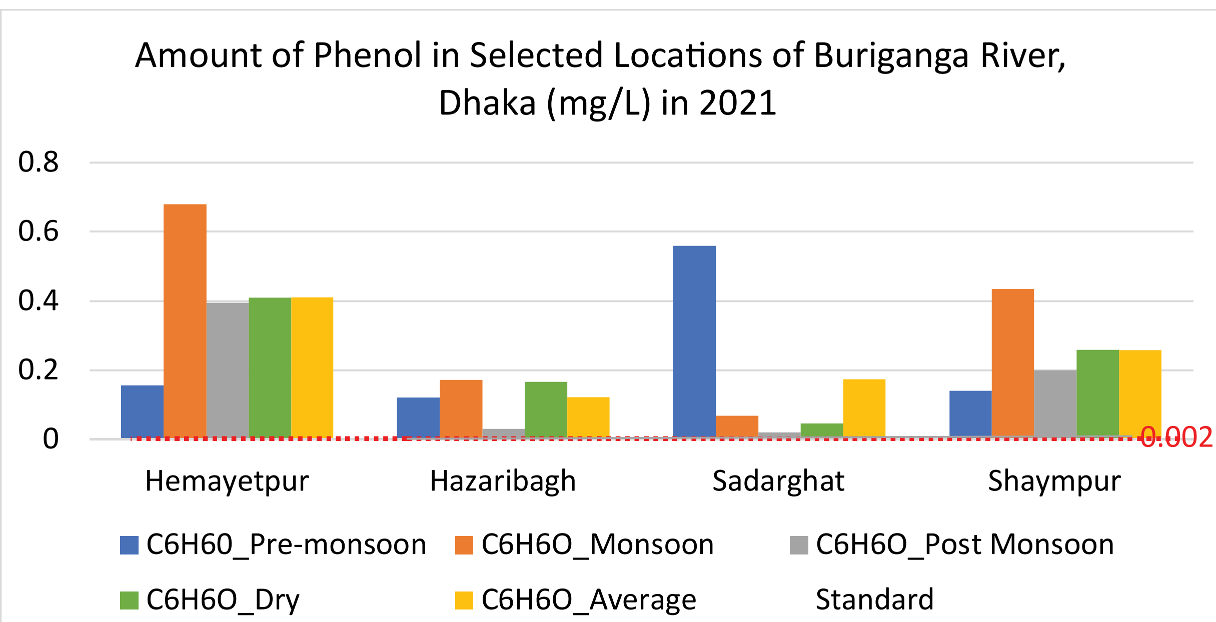


Figure 17: Amount of Phenol in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.10 Spatial and Temporal Dynamics of the Cadmium in 2021

Every station shows a minimal amount of Cadmium activity which is 0.001. This amount is lower than the standard rate of Cadmium in Water (figure-18).

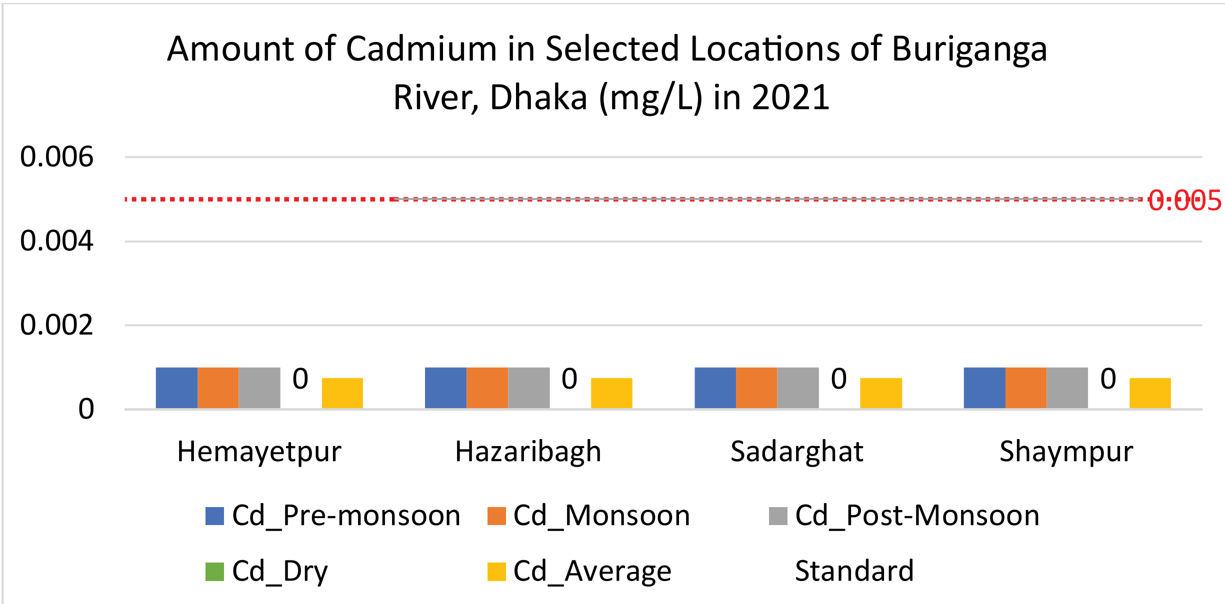


Figure 18: Amount of Cadmium in Selected Locations of Buriganga River, Dhaka (mg/L) in 2021

3.1.11 Seasonal Comparative Analysis of Water Pollution of 2021 and 2022

Comparative analysis is the practise of comparing objects and identifying similarities and differences between them. When a company wishes to evaluate a concept, problem, theory, or topic, it may use a comparative analysis to gain a better understanding of the situation and develop strategies to address it. In the following sections, the yearly comparison between seasons has been illustrated with proper table and graphs.

3.1.12 Pre-Monsoon of 2021 and 2022

In the table 2, the levels of heavy metals in the last two year's pre-monsoon have been illustrated, and detailed analytical texts with necessary graphs have been described in later sections.

Table 2: The Situation of Heavy metal Contamination in Pre-monsoon Season in the Last Two Years

		NTI	OTI	SS	S D S
	Average	7.6	6.975	7.425	7.1
Ph	2021	7.1	7	7.6	7.6
	2022	7.9	7.4	7.3	8.3
	Average	339.25	165.75	32	138.5
TSS	2021	74	116	26	108
	2022	23	67	123	140
	Average	947.25	267	39.5	273
COD	2021	230	318	48	190
	2022	70	99	56	331
	Average	188.75	115.25	17.75	120.5
BOD	2021	54	102	25	87
	2022	9	41	19	172
	Average	13.6	6.15	3.125	6.95
NH_3	2021	24	0.4	5.7	4.8
	2022	17	24	17	19
	Average	2.05	5	0.65	12.775
O&G	2021	1	6.8	0.5	2.6
	2022	0	2.9	8.1	28
	Average	0.665	0.66	0.1975	4.1025
S_2	2021	0.6	0.7	0.6	0.7
	2022	0.13	1.07	0.08	0.96
	Average	0.41025	0.12225	0.1735	0.2585
C_6H_6O	2021	0.156	0.121	0.56	0.14
	2022	0.094	0.126	0.068	0.1
	Average	0.00075	0.00075	0.00075	0.00075
Cd	2021	0.001	0.001	0.001	0.001
	2022	0	0	0	0

3.1.13 Level of pH

In pre-monsoon 2022, every point shows a higher value than the average 2021's result apart from the Sadarghat point.

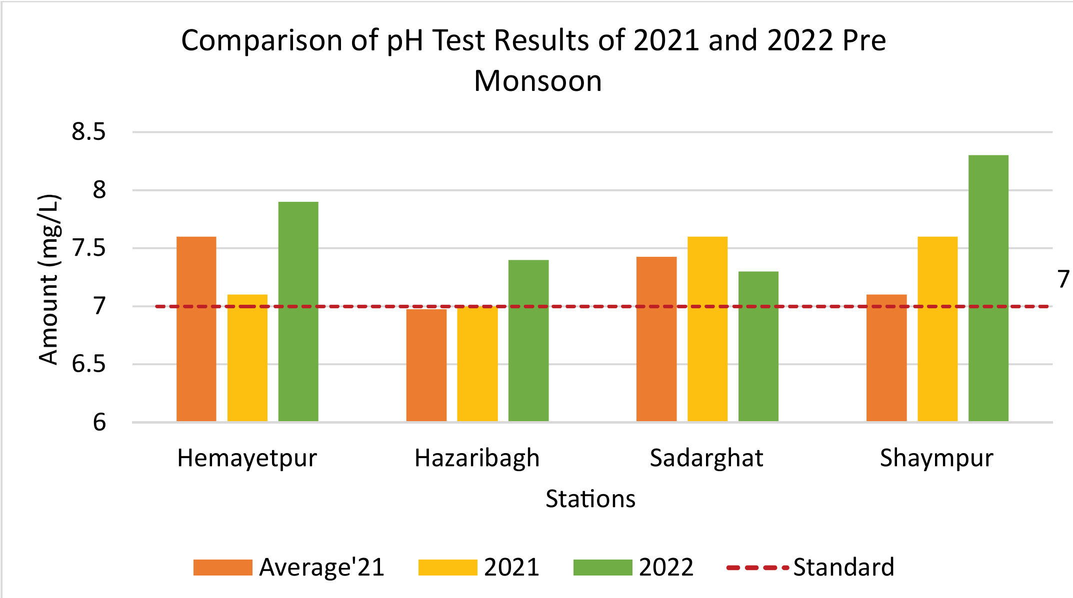


Figure 19: Comparison of pH Test Results of 2021 and 2022 Pre-Monsoon

3.1.14 Level of Total Suspended Solids (TSS)

In Sadarghat, the level of TSS is higher in 2022 than the previous years of 2021, whereas the other station remains low (figure-20). Nevertheless, every station is higher than the standard level.

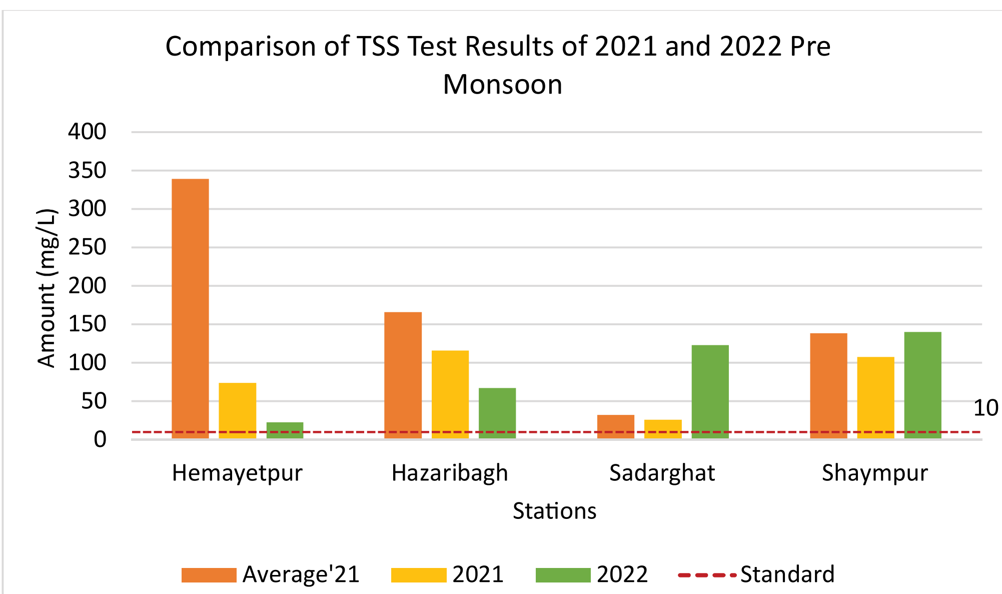


Figure 20: Comparison of TSS Test Results of 2021 and 2022 Pre-Monsoon

3.1.15 Level of COD

In Figure-21, only Shyampur shows a higher trend than the previous year, and other stations are lower than the previous year but higher than the standard.

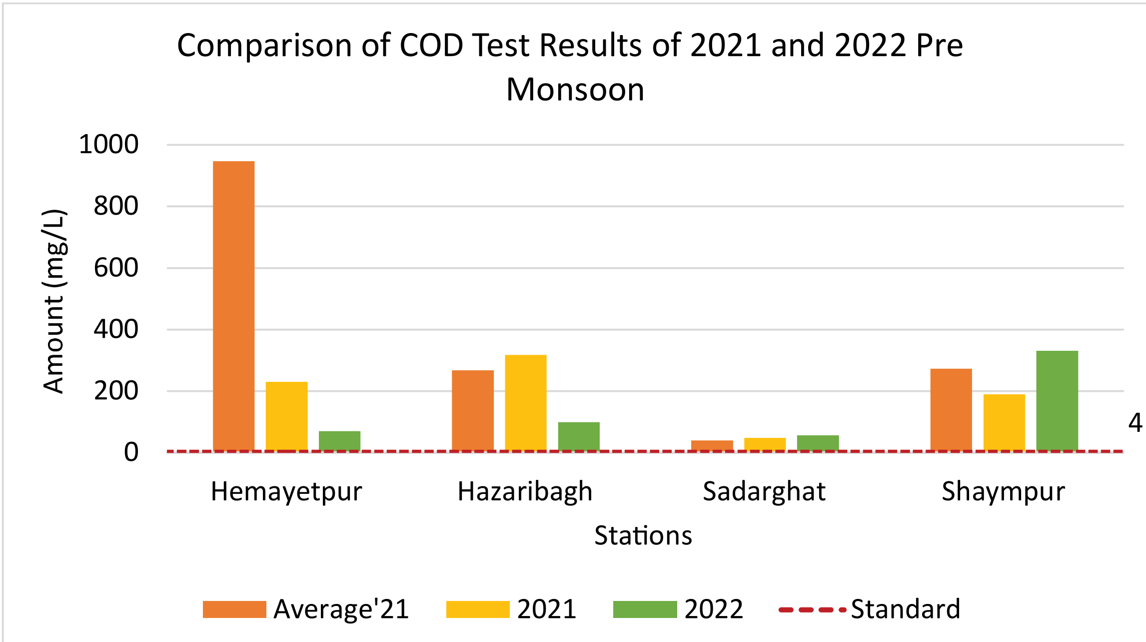


Figure 21: Comparison of COD Test Results of 2021 and 2022 Pre-Monsoon

3.1.16 Level of BOD

Figure-22 shows that every station has a very high level of BOD, and only Shyampur shows the trend of being higher than the previous year.

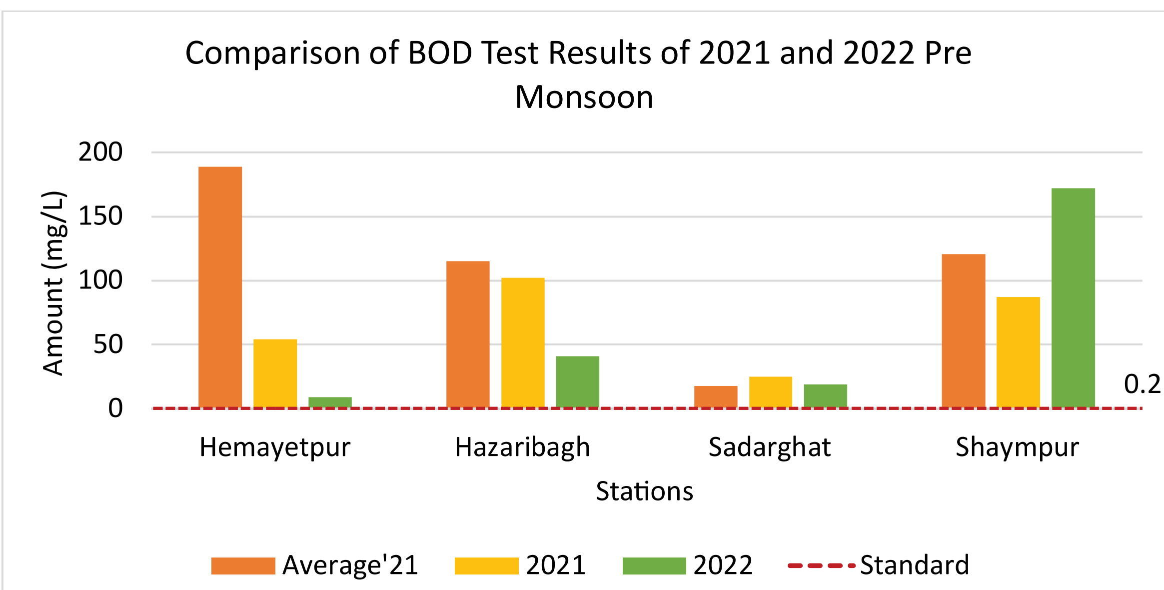


Figure 22: Comparison of BOD Test Results of 2021 and 2022 Pre-Monsoon

3.1.17 Level of Ammonia

Figure-23 shows that Only in Hemayetpur, the ammonia level is low this year; all other stations show very high levels of ammonia this year.

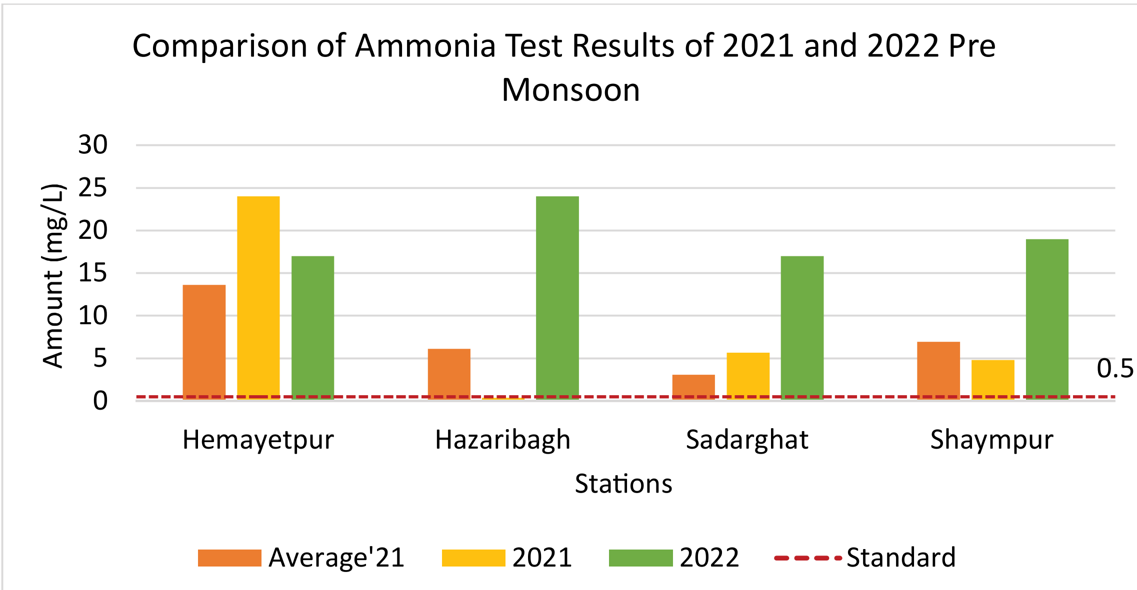


Figure 23: Comparison of Ammonia Test Results of 2021 and 2022 Pre-Monsoon

3.1.18 Level of Oil and Grease

In figure-24 Shyampur shows a higher O&G level in 2022 than the previous year, whereas other stations remain lower.

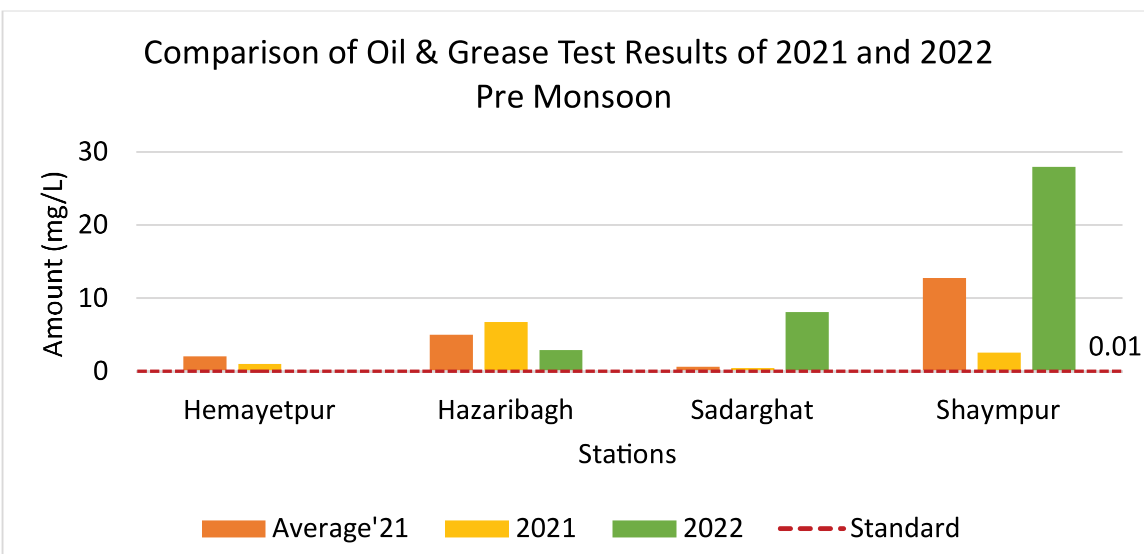


Figure 24: Comparison of Oil & Grease Test Results of 2021 and 2022 Pre-Monsoon

3.1.19 Level of Sulphides

Figure-25 shows the level of Sulphides is lower than the standard level in every station.

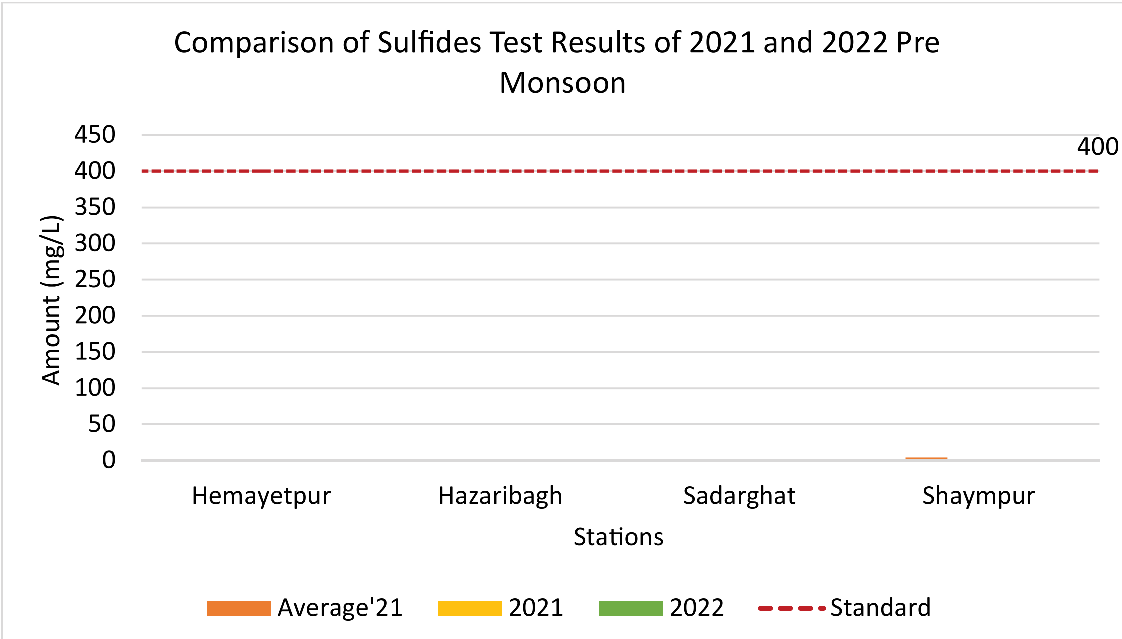


Figure 25: Comparison of Sulphides Test Results of 2021 and 2022 Pre-Monsoon

3.1.20 Level of Phenol

Though every station shows a higher level of phenol contamination in Pre-monsoon, no station exceeds the previous year's level in 2022 (figure 26).

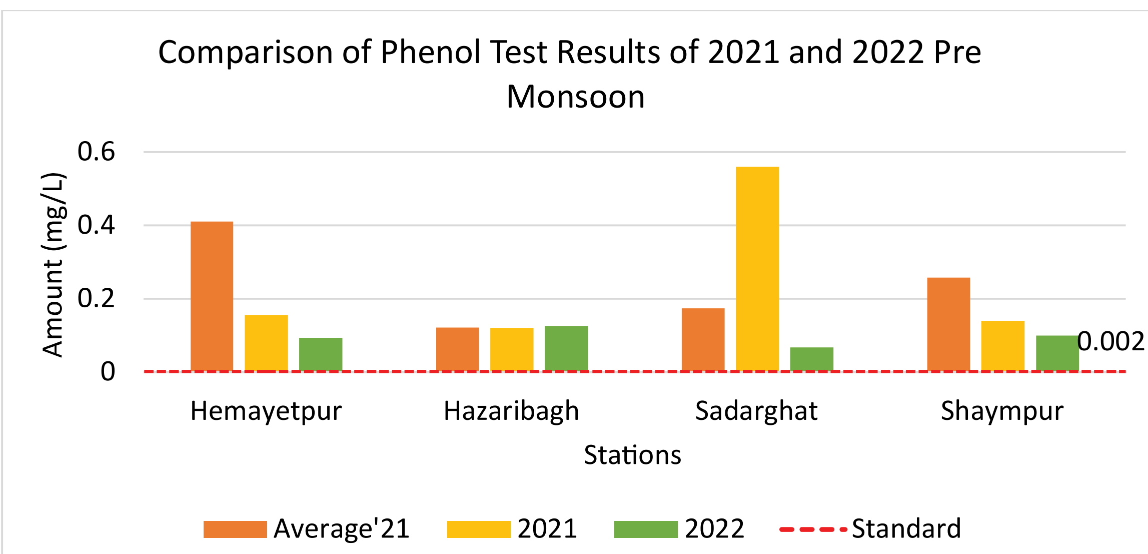


Figure 26: Comparison of Phenol Test Results of 2021 and 2022 Pre-Monsoon

3.1.21 Level of Cadmium

Every station shows a minimal amount of Cadmium activity which is 0.001, in 2021; however, no station shows any activity of cadmium this year's pre-monsoon (figure-27). This amount is lower than the standard rate of Cadmium in Water.

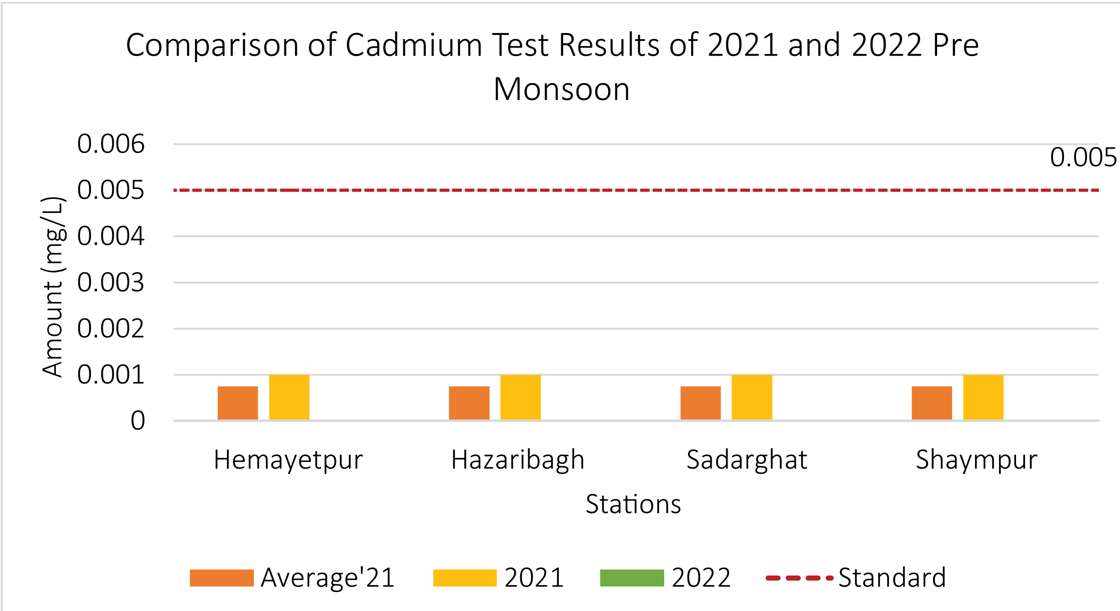


Figure 27: Comparison of Cadmium Test Results of 2021 and 2022 Pre-Monsoon

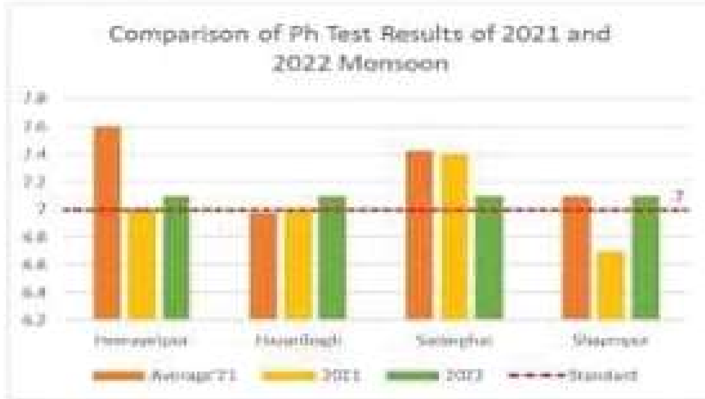
Data shows that heavy metal contamination is very high in the water of the Buriganga River, Dhaka. Which is a clear sign of urban pollution, which should be reduced. Otherwise, the life below the water and the human dependence on it will continue to face water-related problems such as waterborne diseases.

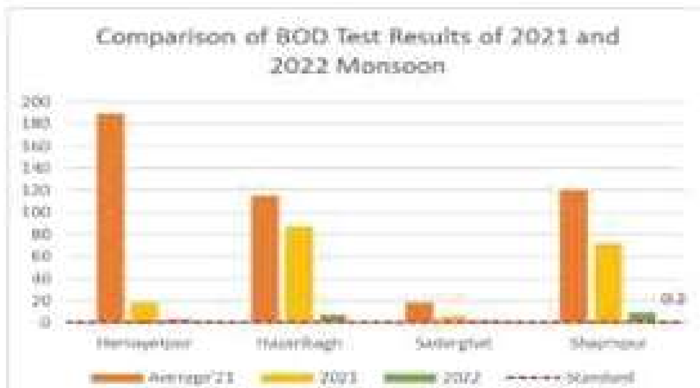
3.1.22 Monsoon of 2021 and 2022

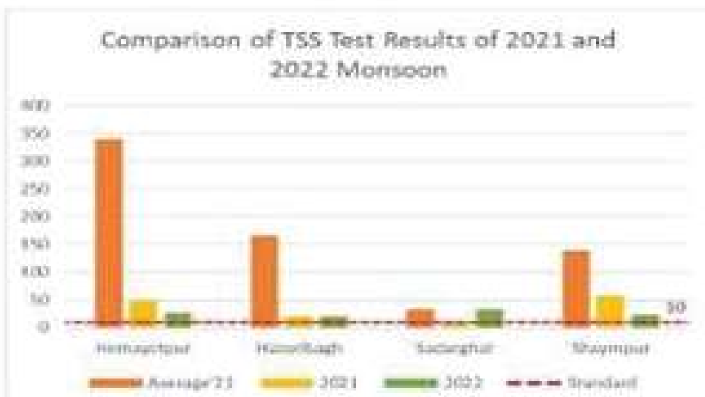
Table 3: The situation of Heavymetal contamination in Monsoon season in the last two years

		NTI	OTI	SS	S D S
	Average	7.6	6.975	7.425	7.1
Ph	2021	7	7	7.4	6.7
	2022	7.1	7.1	7.1	7.1
	Average	339.25	165.75	32	138.5
TSS	2021	48	21	9	57
	2022	36	0	81	24
	Average	947.25	267	39.5	273
COD	2021	337	182	22	227
	2022	24	81	0	36
	Average	188.75	115.25	17.75	120.5
BOD	2021	18	87	6	72
	2022	3	7	2	9
	Average	13.6	6.15	3.125	6.95
NH_3	2021	16	0.5	3.2	4.2
	2022	0	0	0.4	0.3
	Average	2.05	5	0.65	12.775
O&G	2021	0.9	1.6	0.5	1.9
	2022	0	0	0	0
	Average	0.665	0.66	0.1975	4.1025
S_2	2021	0.14	0.81	0.01	13.2
	2022	0.09	0.06	0.1	0.07
	Average	0.41025	0.12225	0.1735	0.2585
C_6H_6O	2021	0.68	0.172	0.068	0.435
	2022	0.013	0.001	0.012	0.014
	Average	0.00075	0.00075	0.00075	0.00075
Cd	2021	0.001	0.001	0.001	0.001
	2022	0	0	0	0

In the monsoon season, most of the data showed a good result. Only Shyampur showed a slightly bad result (figure 28). However, most of the parameters are below than the previous monsoon. Only pH count of some stations showed slightly acidic result. Data has been shown in graphs below:


Comparison of Ph Test Results of 2021 and
2022 Monsoon


Comparison of BOD Test Results of 2021 and
2022 Monsoon


Comparison of TSS Test Results of 2021 and
2022 Monsoon

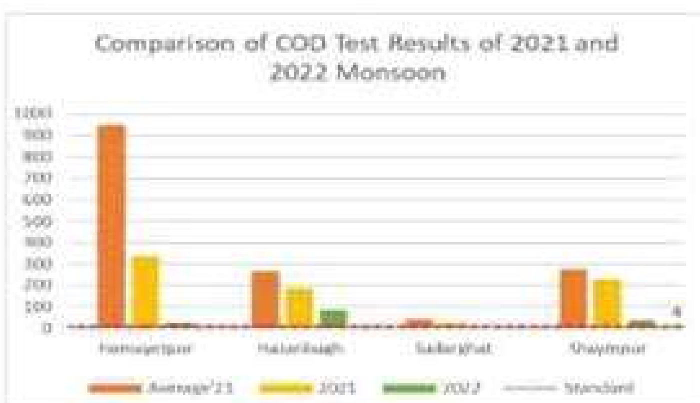

Comparison of COD Test Results of 2021 and
2022 Monsoon

Figure 28: Comparison of pH, TSS, BOD, COD, NH3, Oil and Grease, Phenol and cadmium for the Monsoon season between the years 2021 and 2022

3.1.23 Post-Monsoon of 2021 and 2022

Table 4: The situation of Heavy metal contamination in post-monsoon season in last two years

		NTI	OTI	SS	S D S
	Average	7.6	6.975	7.425	7.1
Ph	2021	8.6	7	7.3	8.5
	2022	7.1	7	7.1	7.2
	Average	339.25	165.75	32	138.5
TSS	2021	1091	84	41	195
	2022	133	55	28	54
	Average	947.25	267	39.5	273
COD	2021	2885	134	16	276
	2022	205	0	50	50
	Average	188.75	115.25	17.75	120.5
BOD	2021	616	76	2	106
	2022	30	3	16	19
	Average	13.6	6.15	3.125	6.95
NH_3	2021	6.1	3.7	0.2	2.8
	2022	4.2	1.35	1.2	4.1
	Average	2.05	5	0.65	12.775
O&G	2021	6.3	8.5	0.5	5.6
	2022	0	0	0	0
	Average	0.665	0.66	0.1975	4.1025
S_2	2021	1.67	0.08	0.05	1.8
	2022	0.2	0.05	0.06	0.1
	Average	0.41025	0.12225	0.1735	0.2585
C_6H_6O	2021	0.395	0.03	0.02	0.2
	2022	0.592	0.008	0.006	0.018
	Average	0.00075	0.00075	0.00075	0.00075
Cd	2021	0.001	0.001	0.001	0.001
	2022	0	0	0	0

Following the previous trend, most of the station showed better result in the post monsoon of 2022 than the previous year with a higher value of every single parameter in Hemayetpur and slightly higher in Shyampur point. In post-monsoon 2022, every station showed an acidic result, whereas in the previous year, the results were slightly alkalic. In Sadarghat and Hazaribagh, the level of TSS is higher than the post monsoon of previous years, whereas the other station remains low. Nevertheless, every station is higher than the standard level. All stations are lower than the previous year but higher than the standard in the post-monsoon in terms of COD, Ammonia, Oil and Grease, and Phenol. Every station has a very high level of BOD, and only Hemayetpur shows the trend of being higher than the previous year. No station crossed the standard of sulphate and cadmium. In the following charts (figure-30) the differences have been illustrated.

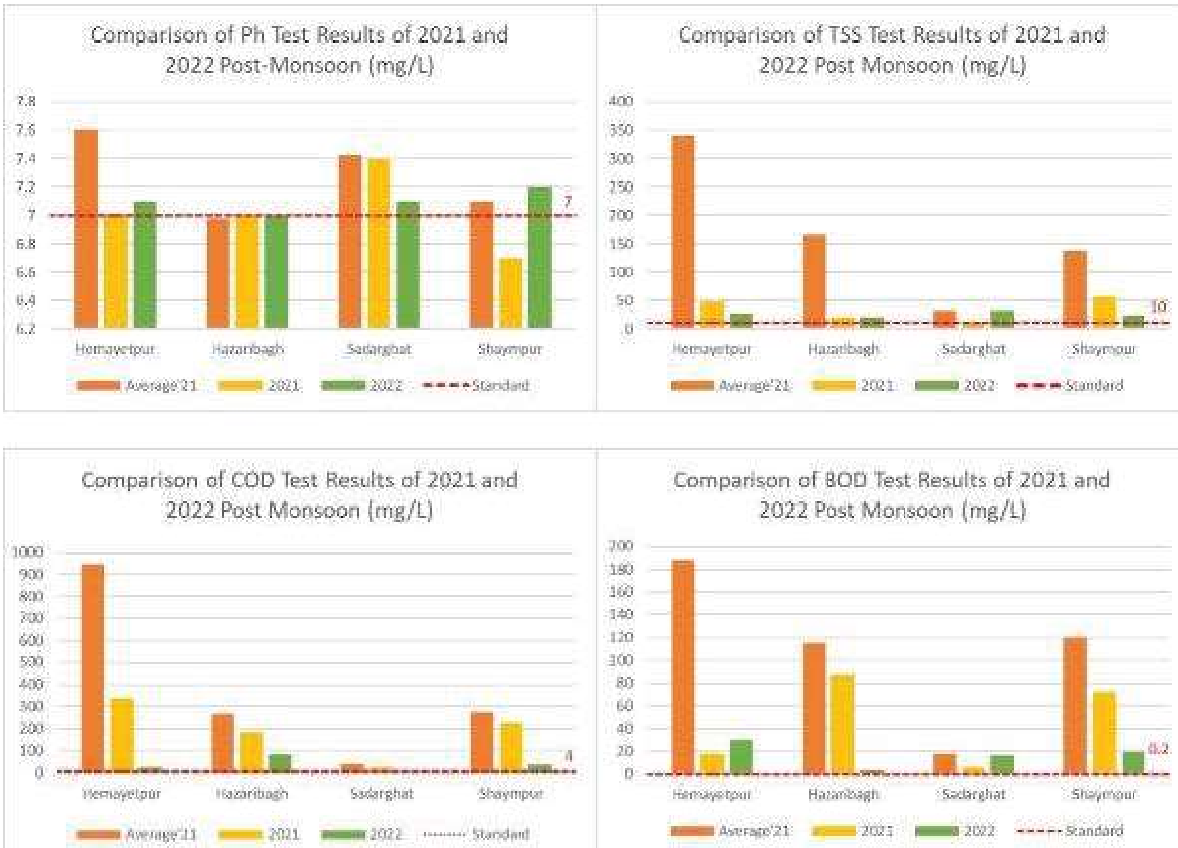


Figure 29: Comparison of pH, TSS, BOD, COD for the post-monsoon season between the years 2021 and 2022

3.1.24 Pre-Season of 2021 and 2022

Following the previous trend, most of the station showed better result in the post monsoon of 2022 than the previous year with a higher value of every single parameter in Hemayetpur and slightly higher in Shyampur point (figure-30). In post-monsoon 2022, every point shows a higher value than 2021's dry season apart from the Hazaribagh. Only Shyampur showed slightly acidic results. In Sadarghat, the level of TSS is higher than the previous years, whereas the other station remains low. Nevertheless, every station is higher than the standard level.

Figure 30: Comparison of pH, TSS, BOD, COD and phenol for the pre-monsoon season between the years 2021 and 2022

All stations are lower than the previous year but higher than the standard in the dry season in terms of COD, Ammonia, and Phenol. Every station has a very high level of BOD, and Sadarghat and Hemayetpur shows the trend of being higher than the previous year. No station crossed the standard of sulphides and cadmium in dry seasons also.

Table 5: The situation of Heavy metal contamination in dry seasons of the last two years

		NTI	OTI	SS	S D S
	Average	7.6	6.975	7.425	7.1
Ph	2021	7	7	7.4	6.7
	2022	7.1	7	7.1	7.2
	Average	339.25	165.75	32	138.5
TSS	2021	48	21	9	57
	2022	27	21	32	24
	Average	947.25	267	39.5	273
COD	2021	337	182	22	227
	2022	24	81	0	36
	Average	188.75	115.25	17.75	120.5
BOD	2021	18	87	6	72
	2022	30	3	16	19
	Average	13.6	6.15	3.125	6.95
NH_3	2021	16	0.5	3.2	4.2
	2022	0	0	0.4	0.3
	Average	2.05	5	0.65	12.775
O&G	2021	0.9	1.6	0.5	1.9
	2022	0	0	0	0
	Average	0.665	0.66	0.1975	4.1025
S_2	2021	0.14	0.81	0.01	0.07
	2022	0.07	0.06	0.1	0.07
	Average	0.41025	0.12225	0.1735	0.2585
C_6H_6O	2021	0.68	0.172	0.068	0.435
	2022	0.013	0.001	0.012	0.014
	Average	0.00075	0.00075	0.00075	0.00075
Cd	2021	0.001	0.001	0.001	0.001
	2022	0	0	0	0

3.1.25 Comparison of Findings with DoE Data

Department of Environment (DoE) under Ministry of Environment, Forest and Climate Change is the authoritative body of the Peoples' Republic of Bangladesh Government for Environmental stewardship. They publish water quality report every year. However, the parameters selected by the DoE and this study is not same, only pH, COD, BOD and SS is common parameters between the studies (figure-31). In the following sections, level of pH, COD, BOD and SS collected by the DoE in 2017 of Hazaribagh and Sadarghat has been illustrated.

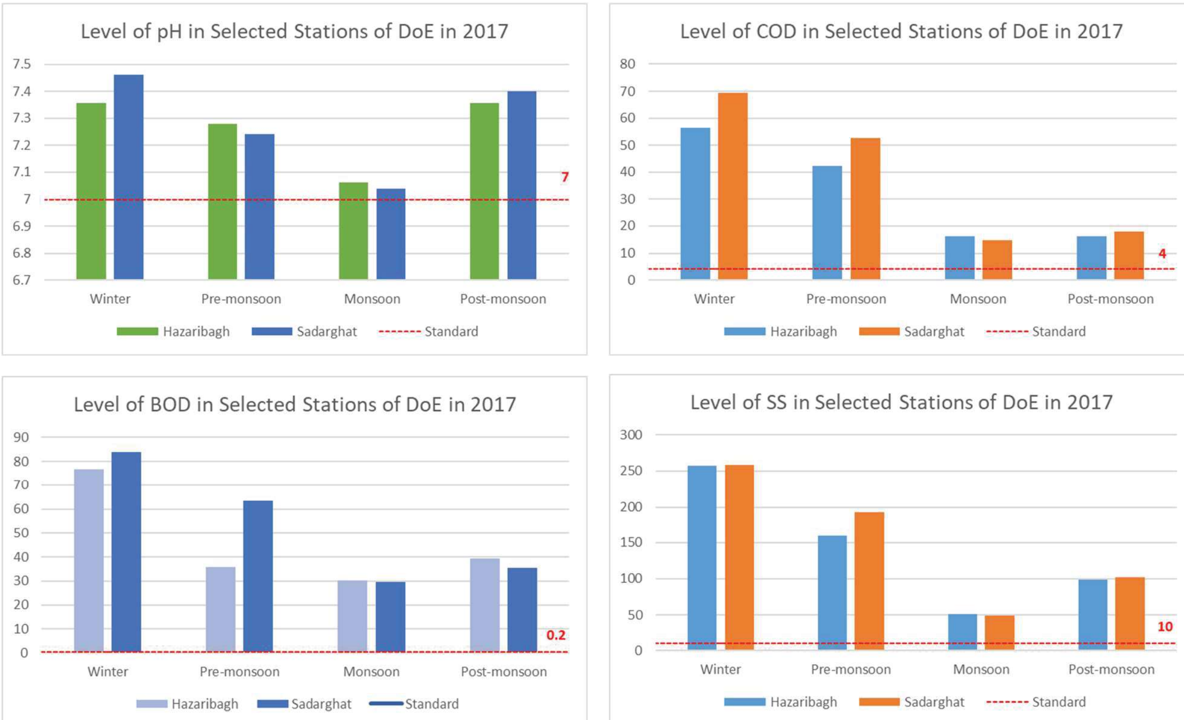


Figure 31: Seasonal variations of pH, BOD, COD and suspended solids in 2021

The DoE Data also exceeds the standard. Winter shows the highest amount of pH, COD and BOD, whereas the monsoon remains the lowest (figure-32) In our study, we also found the same pattern of water quality increase or decrease. So, it can be said that, this study also sings in the same tone. In the following graph, a trend of Suspended Solids has been shown combining both study for Hazaribagh.

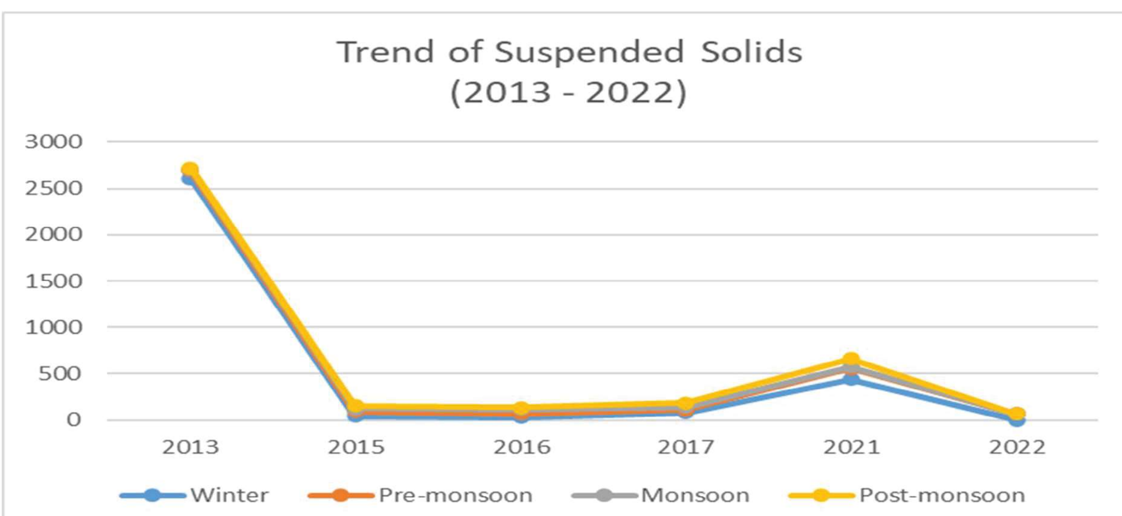


Figure 32: Temporal dynamics suspended solids during 2013-2022

3.1.26 Water Quality Assessment

CCME method has been deployed in order to find out the Water quality index (WQI) to assess the water quality of the Buriganga and Dhaleswari rivers using the analytical data derived from Intertek. The sites are located near the new tannery industry (NTI) at Hemayetpur in the Dhaleswari River, Shyampur Dyeing Industry area (SDS), Sadarghat spot (SS) and Hazaribagh (OTI) in the Buriganga. The water quality is rated as poor to marginal (CCME WQI values range from 38.93 to 46.62) which indicates frequent and mostly threatened shows the details of calculations regarding the WQIs for the four sites. Low values of the water quality index (WQI) have been attributed to a high level of trace metals for all four sampling sites. This suggests that there is a common factor is the abundant effluent flow to the river without any treatment, which acts as a causative phenomenon in lowering water quality. The prospective use of WQIs to examine the impacts of abandoned industrial pollutants may have some aptitude to make the water quality better, though furthermore sampling programs and additional multivariate statistical approaches would be required with the CCME WQI method.

Stations	Results WQI
1. NTI	29.44
2. OTI	38.10
2. SS	46.64
2. SDS	32.21

CCME WQI	Ranking	Water Quality Charecteristics
95 - 100	Excellent	Water quality is protected with a Virtual absence of threat. Condition very close to natural and pristine levels
80 - 94	Good	Water Quality is protected with only a minor degree of threat or impairment; conditions rarely depart from desirable levels
65 - 79	Fair	Water Quality is usually protected but occasionally threatened or impair; conditions sometimes depart from desirable levels
45 – 64	Marginal	Water Quality is frequently threatened or impaired. Conditions after depart from natural or desirable Level
0 – 44	Poor	Water Quality is almost always threatened or impaired. Conditions usually after depart from natural or desirable level

Figure 33: CCME Water Quality Index of 2021

The WQI results noticeably direct that the water must be treated to eliminate the physical dirt, chemicals and metals to sustain the river ecosystem. In terms of aquatic life, fresh water is favorable. In summary, the water quality of the Buriganga and Dhaleswari rivers ranges from marginal to poor quality, which is frequently and almost always threatened or impaired. There is a need to reduce both organic and inorganic substances in the water. This can be done through proper implementation of ETP at the sources point of the effluent flow industries. An effective measure also require for appropriate treatment of water for any use in industrial and domestic purposes. This information may be worthwhile for advocacy planning and effective legislative measures for controlling effluent contributing industries along the river bank. In figure 33 the result showed that only Sadarghat showed a marginal ranking in the water quality and all other stations showed poor quality of water . Although the overall water quality indexing scenario improved in 2022, the result from Shyampur Dyeing Industry is lower than the previous year's total as well as the first half of 2021. Nevertheless, the other three stations ranked marginal in 2022 where the Hemayetpur New Tannery area showed the best result among the three (figure-34). In 2021, the water quality of Sadarghat was better, whereas Hemayetpur ranked first in 2022, although it is still in the marginal rank which is not drinkable or even usable. The result showed that only Shyampur showed a poor ranking in water quality and all other stations showed marginal water quality.

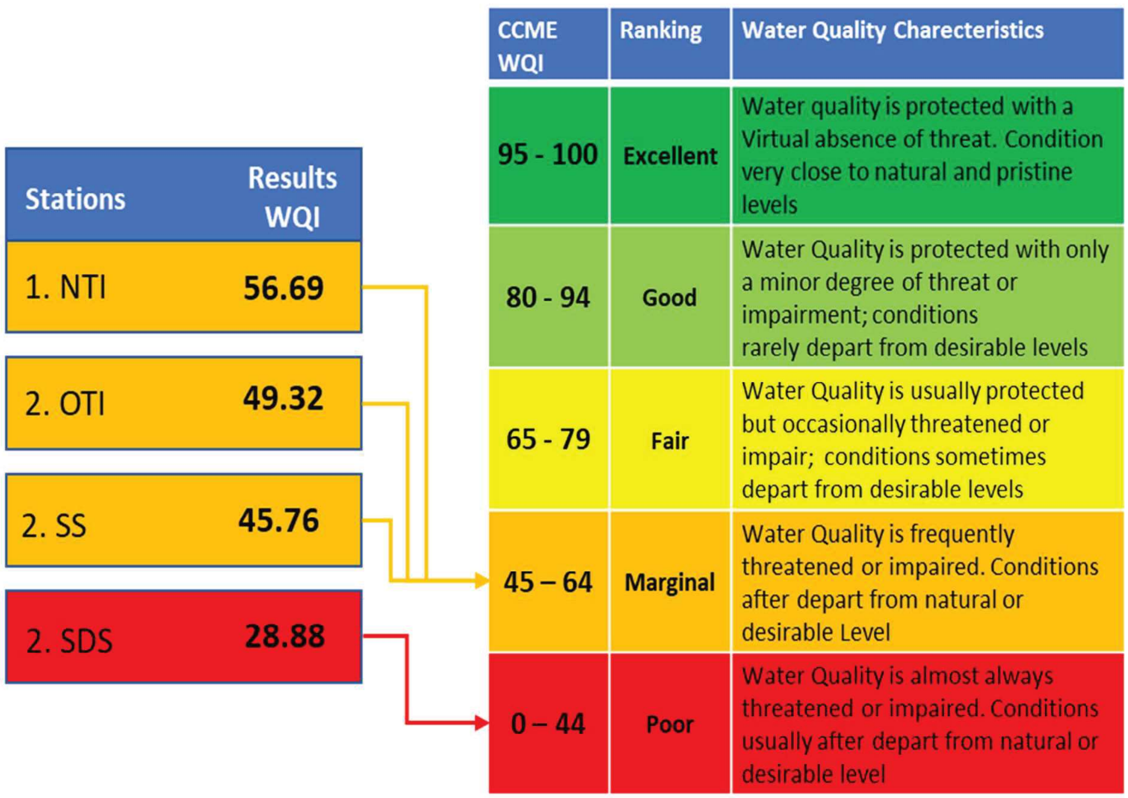


Figure 34: CCME Water Quality Index of 2022

3.1.27 Water Quality Index of Pre-Monsoon and Monsoon

Two further CCME test has been done for the Pre Monsoon and Monsoon seasons of 2021 and 2022 for comparison. The test results are shown below:

3.1.28 Water Quality Index of Pre-Monsoon and Monsoon of 2021

In the first half of 2021, the water quality was better for the Hazaribagh area as it is showing a relatively better result in the water quality indexing. Although, the water quality of Hemayetpur and Shyampur also improved, but it remained in the poor category (figure-35).

The water quality result of Sadarghat slightly changed but it did not change the position of the station in the marginal category. The result showed that both Hazaribagh and Sadarghat showed a marginal ranking in the water quality and all other stations showed poor quality in terms of water quality.

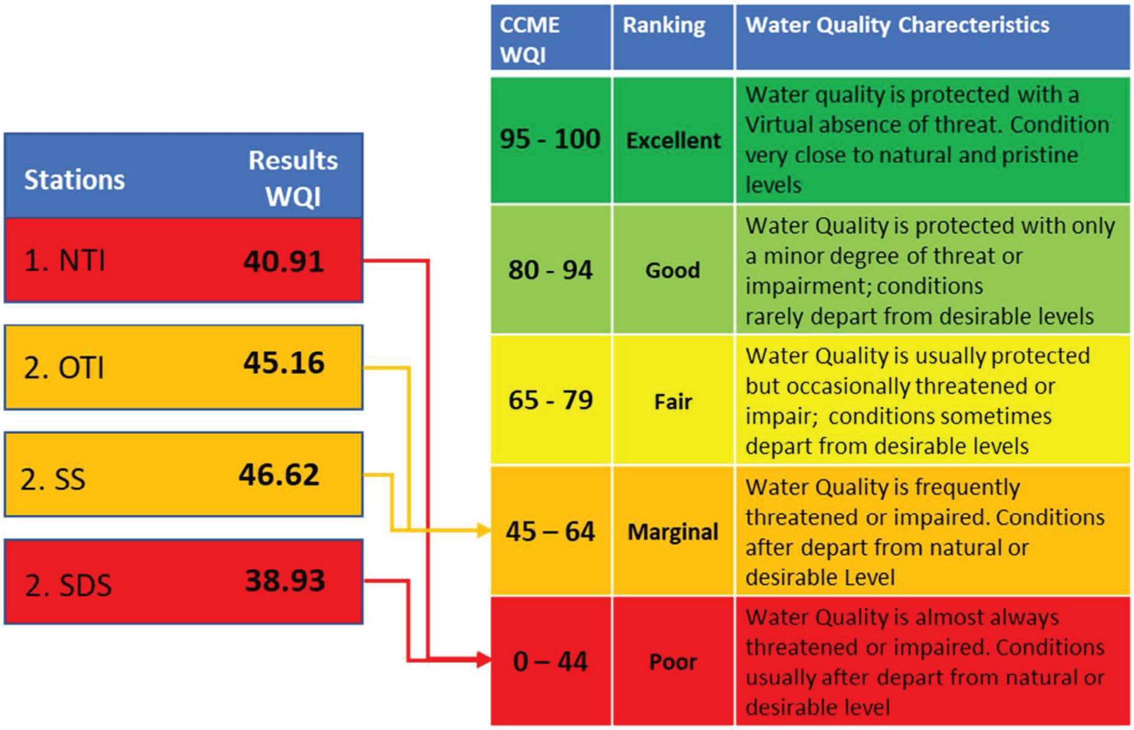


Figure 35: CCME Water Quality Index of Pre-Monsoon and Monsoon season, 2021

3.1.29 Water Quality Index of Pre-Monsoon and Monsoon of 2022

Although the overall water quality indexing scenario improved in 2022, the result from Shyampur Dyeing Industry is lower than the previous years total as well as the first half of 2021. Nevertheless, the other three stations ranked marginal in 2022 where the Hemayetpur new tannery area showed the best result among the three (figure-36). In 2021, the water quality of Sadarghat was better, whereas, Hemayetpur ranked first in 2022, although it is still in the marginal rank which is not drinkable or even usable. The result showed that three stations, Hemayetpur, Hazaribagh and Sadarghat showed a marginal ranking in the water quality and only Shyampur showed poor quality in terms of water quali-ty.

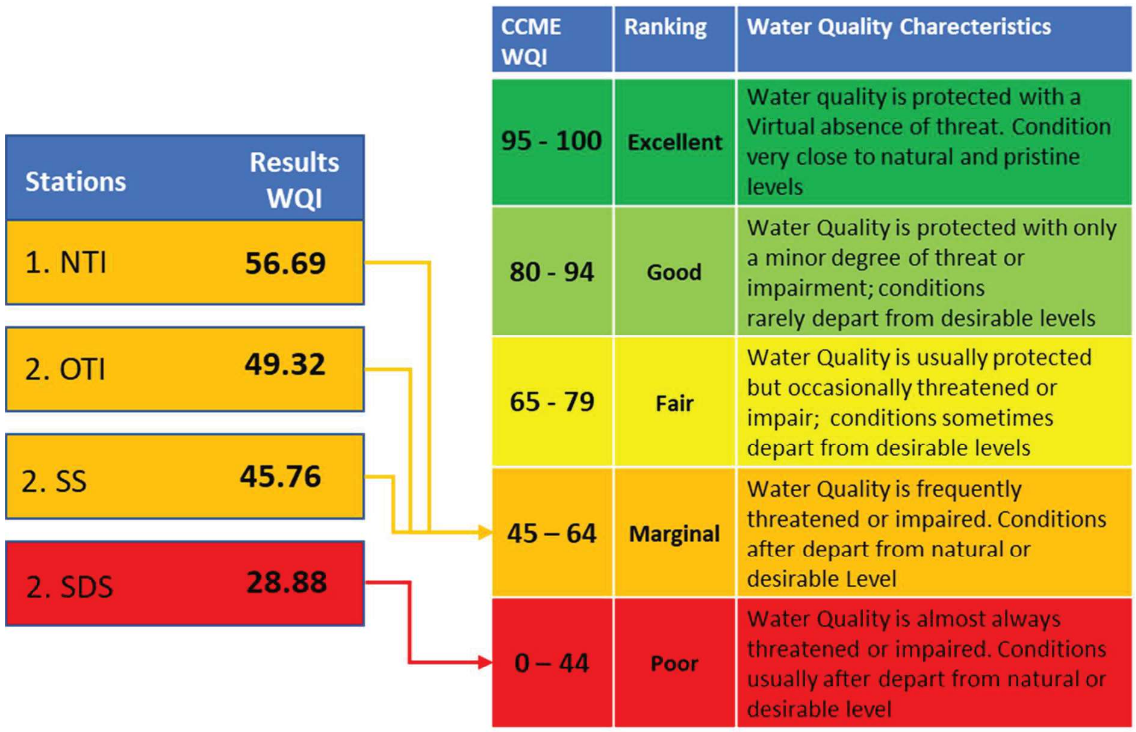


Figure 36: CCME Water Quality Index of Pre-Monsoon and Monsoon season, 2022

In the following graph (figure-37), a comparative situation of the first half of 2022 and 2021 and total 2021's scenario has been shown:

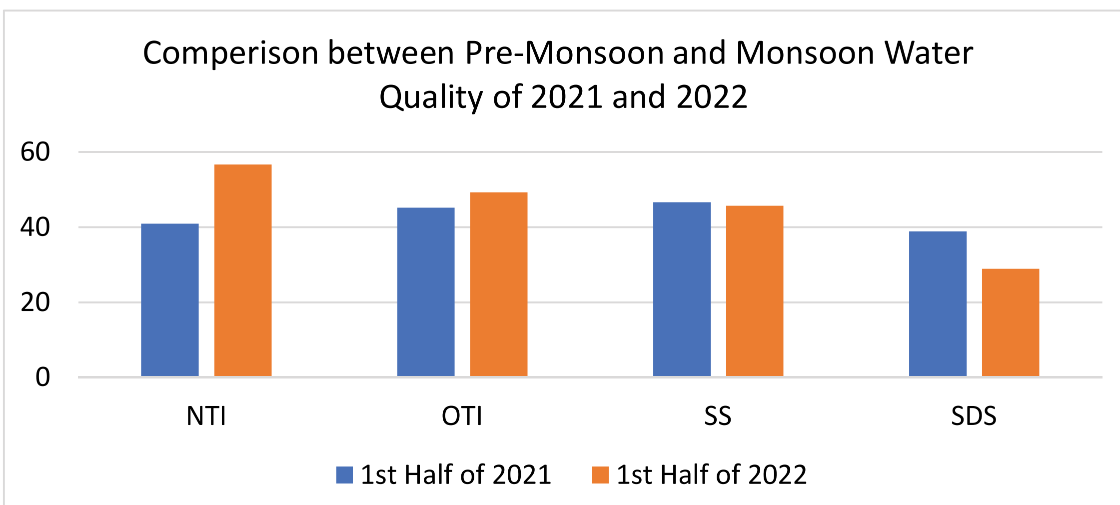


Figure 37: Comparative scenarios of CCME Index of Water quality between pre-monsoon and monsoon seasons of 2021 and 2022

Data shows that heavy metal contamination is very high in the water of the Buriganga river, Dhaka. Most of the stations are ranked poor in the CCME water quality index. This is a clear sign of urban pollution, which should be reduced. Otherwise, the life below the water and the human dependence on it will continue to face water-related problems waterborne diseases.

3.2 State of Air Quality in Dhaka

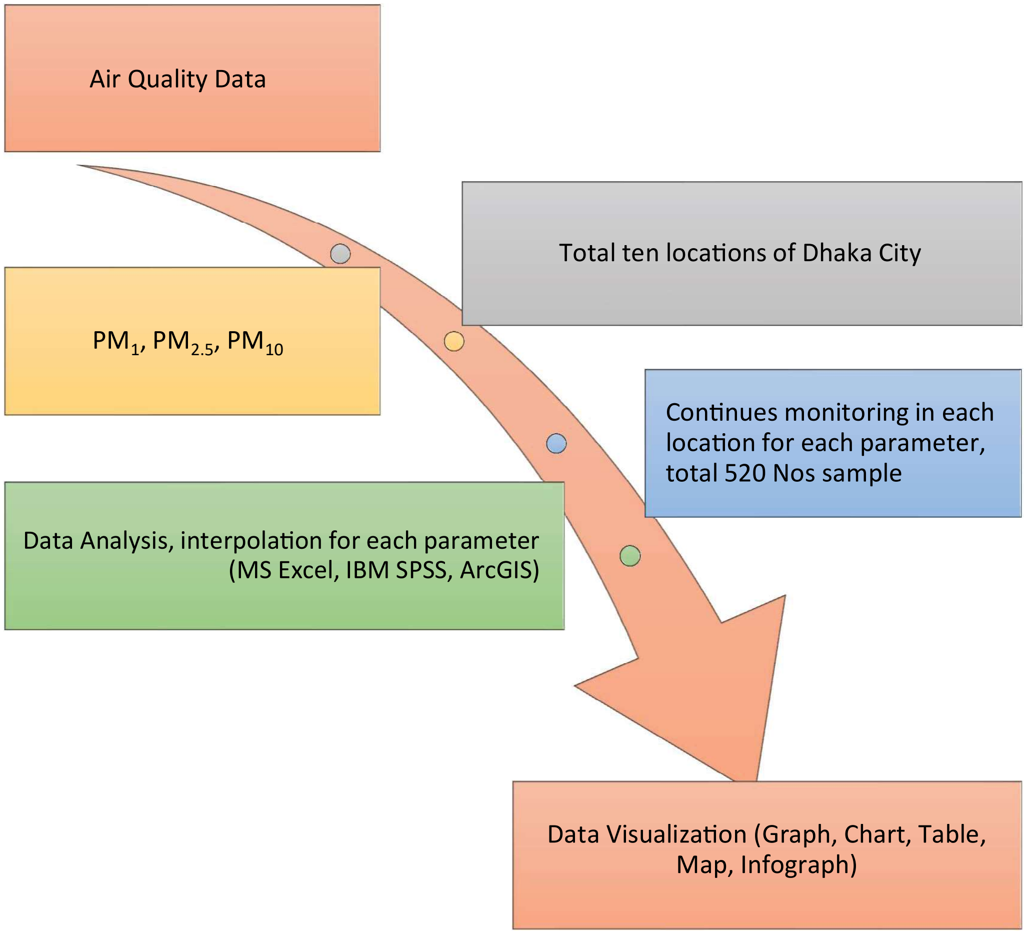


Figure 38: Workflow diagram of air quality analysis

In the above diagram (figure-38) an overall revision of the study of Air quality workflow has been presented. The mean concertation of PM_1, $PM_{2.5}$ and PM_{10} over selected sites during the study period April 2021 to March 2022 is shown in Figure 40 and Figure 41 respectively. The annual mean concentration of $PM_{2.5}$ was 73 µg/m³ which is 4.9 times higher than annual standard (15 µg/m³) and PM_{10} was and 113 µg/m³ which is 2.3 times higher than annual standard (50 µg/m³). Meanwhile, the highest annual mean concentration of $PM_{2.5}$ and PM_{10} both found in Shahbag and the values were 91.4 µg/m³ and 147.1 µg/m³ respectively; indicated by the purple colour in the map while lowest annual mean concentration found in Parliament area 59.4 µg/m³ and 87.6 µg/m³ respectively indicated by green colour in the map. The annual concentration of all sampling sites and their rank based on concentration is shown in Table-7. It reveals that all sampling sites concentration exceed Bangladesh National Ambient Air Quality Standard (BNAAQS).

Table 6: Annual concentration of PM_1, $PM_{2.5}$ and PM_{10} in 10 selected sites of Dhaka City

Locations	PM_1 Concentration (μg/m³)	$PM_{2.5}$ Concentration (μg/m³)	Rank Based on $PM_{2.5}$ Concentration	Concentration Exceed BD Standard (15 μg/m³)	PM_{10} Concentration (μg/m³)	Rank Based on PM_{10} Concentration	Concentration Exceed BD Standard (50 μg/m³)
Shahbag	48.3	91.4	1	6.1 times	147.1	1	2.9 times
Motijheel	41.5	79.4	2	5.3 times	109.4	5	2.2 times
Agargaon	39.3	74.8	3	5.0 times	121.3	3	2.4 times
Abdullahpur	48.3	74.0	4	4.9 times	130.3	2	2.6 times
Dhanmondi-32	44.7	73.6	5	4.9 times	102.1	8	2 times
Mirpur-10	48.8	72.7	6	4.8 times	119.0	4	2.4 times
Gulshan-2	46.0	71.2	7	4.7 times	106.1	7	2.1 times
Ahsan Manzil	40.5	70.6	8	4.7 times	109.1	6	2.2 times
Tejgaon	42.4	67.0	9	4.5 times	100.7	9	2 times
Parliament Area	37.2	59.4	10	4.0 times	87.6	10	1.8 times
Annual Mean	43.5	73	-	4.9 times	113	-	2.3 times

3.2.1 Status of PM_1

The data shows distinct variations in air pollution levels across seasons. The highest concentrations are observed during the winter season, with Abdullahpur, Dhanmondi-32, Gulshan-2, and Shahbag recording the highest values. Monsoon seasons generally have lower pollution levels compared to the pre-monsoon and winter seasons. This can be attributed to the cleansing effect of rainfall, which helps to wash away pollutants from the air. Post-monsoon seasons show slightly higher pollution levels compared to the monsoon, but still lower than pre-monsoon and winter seasons. Among the listed locations, Shahbag consistently records high pollution levels across all seasons, particularly during winter. Dhanmondi-32 and Gulshan-2 also exhibit high pollution levels during winter but show lower values during the monsoon season. Agargaon and Ahsan Manzil generally have relatively lower pollution levels throughout the year (figure-40).

Table 7: The seasonal concentration of PM_1 over 10 locations of Dhaka city

Locations	Season				
	Pre-monsoon (Mar, Apr, May)	Monsoon (Jun, Jul, Aug, Sep)	Post-monsoon (Oct, Nov)	Winter (Dec, Jan, Feb)	Annual Mean Concentration ($\mu g/m^3$)
Abdullahpur	49.0	22.1	36.6	75.5	46.3
Agargaon	37.1	20.9	29.5	71.2	39.3
Ahsan Manzil	34.5	23.2	30.9	70.6	40.5
Dhanmondi-32	42.0	17.2	28.9	90.6	44.7
Gulshan-2	42.7	22.9	30.7	86.1	46.0
Mirpur-10	51.3	25.6	35.8	84.0	48.8
Motijheel	38.2	18.7	30.6	75.8	41.5
Parliament Area	39.9	16.8	29.4	67.2	37.2
Shahbag	38.2	21.8	33.4	99.0	48.3
Tejgaon	39.6	19.6	36.5	78.9	42.4
Seasonal Mean	41.4	20.8	32.3	79.9	43.5

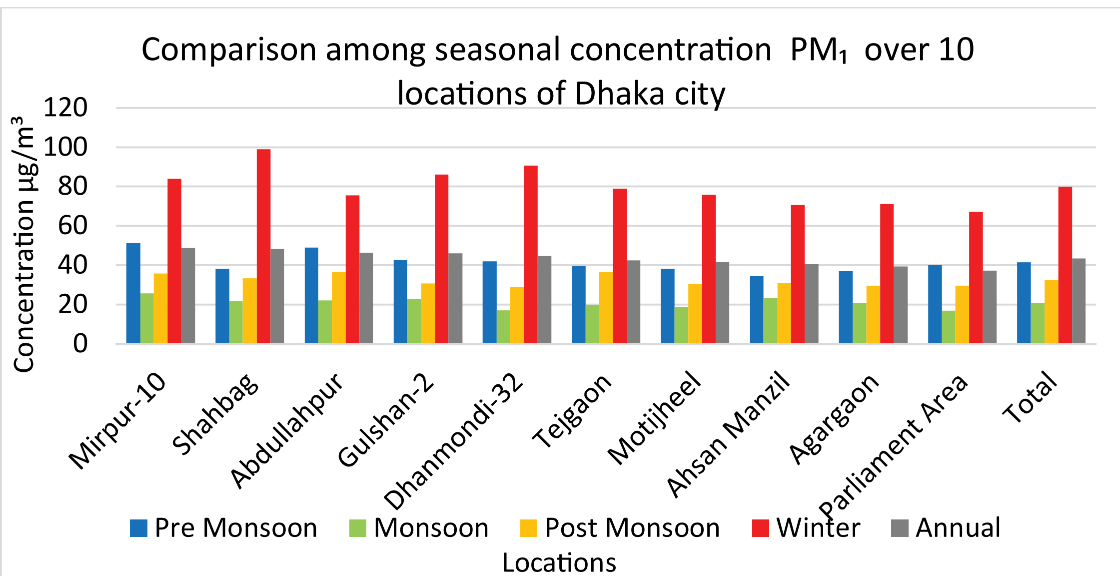


Figure 39: Comparison among seasonal concentration PM_1 over 10 locations of Dhaka city

3.2.2 Status of $PM_{2.5}$

The seasonal concentration of $PM_{2.5}$ over all sampling sites is shown in Table-6. During the pre-monsoon season highest mean concentration of $PM_{2.5}$ was found in Shahbag (77.7 $\mu g/m^3$) and the lowest mean concentration was found in Dhanmondi-32 (47.5 $\mu g/m^3$). The pre-monsoon total mean value was 64.8 $\mu g/m^3$ which is 4.3 times higher than the annual BD standard (15 $\mu g/m^3$).

The monsoon season map shows comparatively lower pollution than pre-monsoon. In monsoon, the highest record was found in the Gulshan-2 (38.8 µg/m³) and the lowest record was found in the parliament area (26.7 µg/m³). The monsoon season total mean value was 33.2 µg/m³, though the concentration is less but the pollution level exceeds 2.2 times compared to the annual BD Standard (15 µg/m³). Again, the pollution level of $PM_{2.5}$ being increased during post -monsoon seasonal highest observe in Tejgaon (91.8 µg/m³) and lowest observe in Gulshan-2 (50.8 µg/m³) was not in good condition. The post-monsoon seasonal mean is 74.9 µg/m³ which was 4.9 times higher than $PM_{2.5}$ annual BD standard. A large concentration of $PM_{2.5}$ has been found in the winter season. The seasonal mean value was 148.9 which was 9.9 times higher than the annual BD Standard (15 µg/m³). The highest record found in Shahbag was 186.1 µg/m³ and the lowest record was found at 131.7 µg/m³ in Mirpur-10 (figure-40).

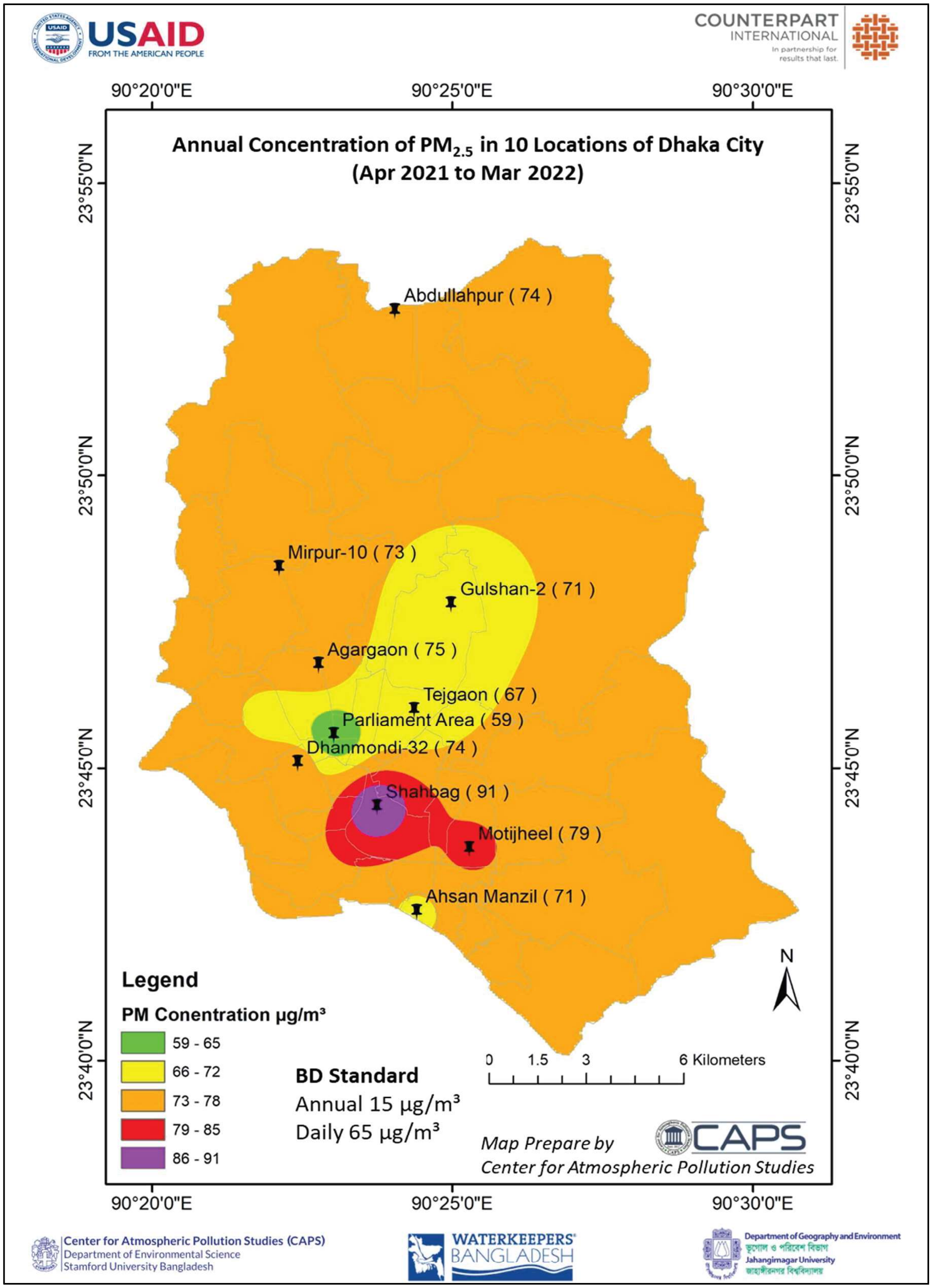


Figure 40: Annual Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City

Table 8: The seasonal concentration of $PM_{2.5}$ over 10 locations of Dhaka city

Locations	Season Concentration (µg/m³) Pre-monsoon (Mar, Apr, May)	Monsoon (Jun, Jul, Aug, Sep)	Post-monsoon (Oct, Nov)	Winter (Dec, Jan, Feb)	Annual Mean Concentration (µg/m³)	Rank Based on Annual Concentration	Annual Concentration Exceed BD Standard (15 µg/m³)
Shahbag	77.7	33.9	86.2	186.1	91.4	1	6.1 times
Motijheel	77.3	28.2	65.2	150.2	79.4	2	5.3 times
Agargaon	64.4	37.5	83.7	139.3	74.8	3	5 times
Abdullahpur	74.2	36.0	75.9	142.2	74.0	4	4.9 times
Dhanmondi-32	47.5	28.8	67.0	170.9	73.6	5	4.9 times
Mirpur-10	67.8	38.1	70.6	131.7	72.7	6	4.8 times
Gulshan-2	70.6	38.8	50.8	146.7	71.2	7	4.7 times
Ahsan Manzil	59.1	33.7	90.1	133.3	70.6	8	4.7 times
Tejgaon	64.8	29.7	91.8	146.4	67.0	9	4.5 times
Parliament Area	53.3	26.7	81.3	138.9	59.4	10	4 times
Total	64.8	33.2	74.9	148.9	73.1		4.9 times

Among 10 locations min annual concentration was found 59.4 µg/m³ at the Parliament area and the max annual concentration of $PM_{2.5}$ has been found 91.4 µg/m³ at Shahbag. However, both are 4 and 6 times higher than the annual BD standard (15 µg/m³) respectively. On the other hand, the annual mean concentration of 10 locations has been found 73.1 µg/m³ which is 4.9 times higher than the standard. Among the four seasons, winter is worse than the other three and comparatively monsoon seasons are best but not a single sample site concentration was found within the standard (figure-41).

Furthermore, $PM_{2.5}$ concentrations for all sampling sites manifested a different variation characteristic, different seasons have different hotspots of pollution (Fig. 43, 44, 45 and 46). Shahbag is the pollution hotspot for pre-monsoon, and Gulshan-2 is the hotspot for Monsoon season. Tejgaon is a hotspot for post-monsoon and finally Shahbag and Dahnmondi-32 cluster hotspots during winter. On the other hand, the Parliament area is the green spot in pre-monsoon and monsoon. Whereas Gulshan-2 and Mipur-10 is the green spot for post-monsoon and winter season respectively.

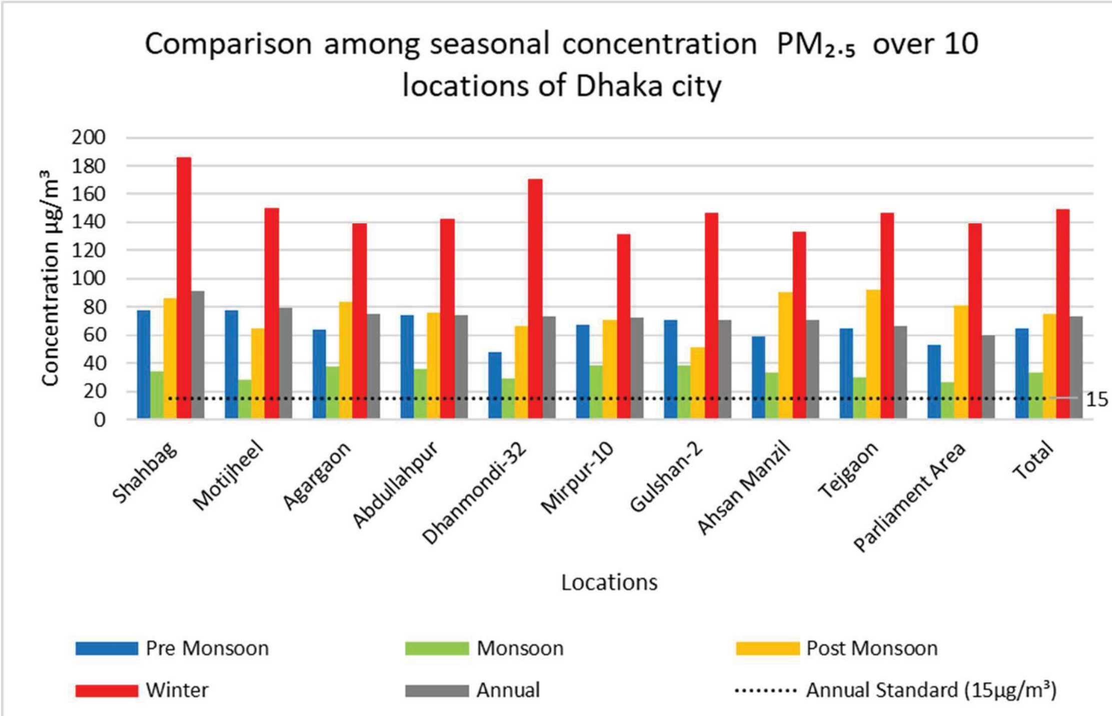


Figure 41: Comparison among seasonal concentration $PM_{2.5}$ over 10 locations of Dhaka city

The reason behind the hotspot and green-spot change is climatic influence and local cause of air pollution. Parliament area is basically known as a silent area, there are sufficient trees and water bodies. That may decrease air pollution in that place beside relative humidity increased in the warm season and decreased in the cold season which may contribute to changes in particulate matter pollution. Moreover, in the winter season to minimize mosquito spreading fogging activity is increased all over the Dhaka city which contributes to increased air pollution. Besides people are burning tree leaves and branches after evening. Shahbag and Gulshan-2 are the busiest locations among the 10 sampling sites. Because of Road intersection mass movement of vehicles has been observed in both locations that were one the major source of particulate pollution. Whereas Tejgaon is an industrial area, pollution may increase due to industrial activity (figure-42).

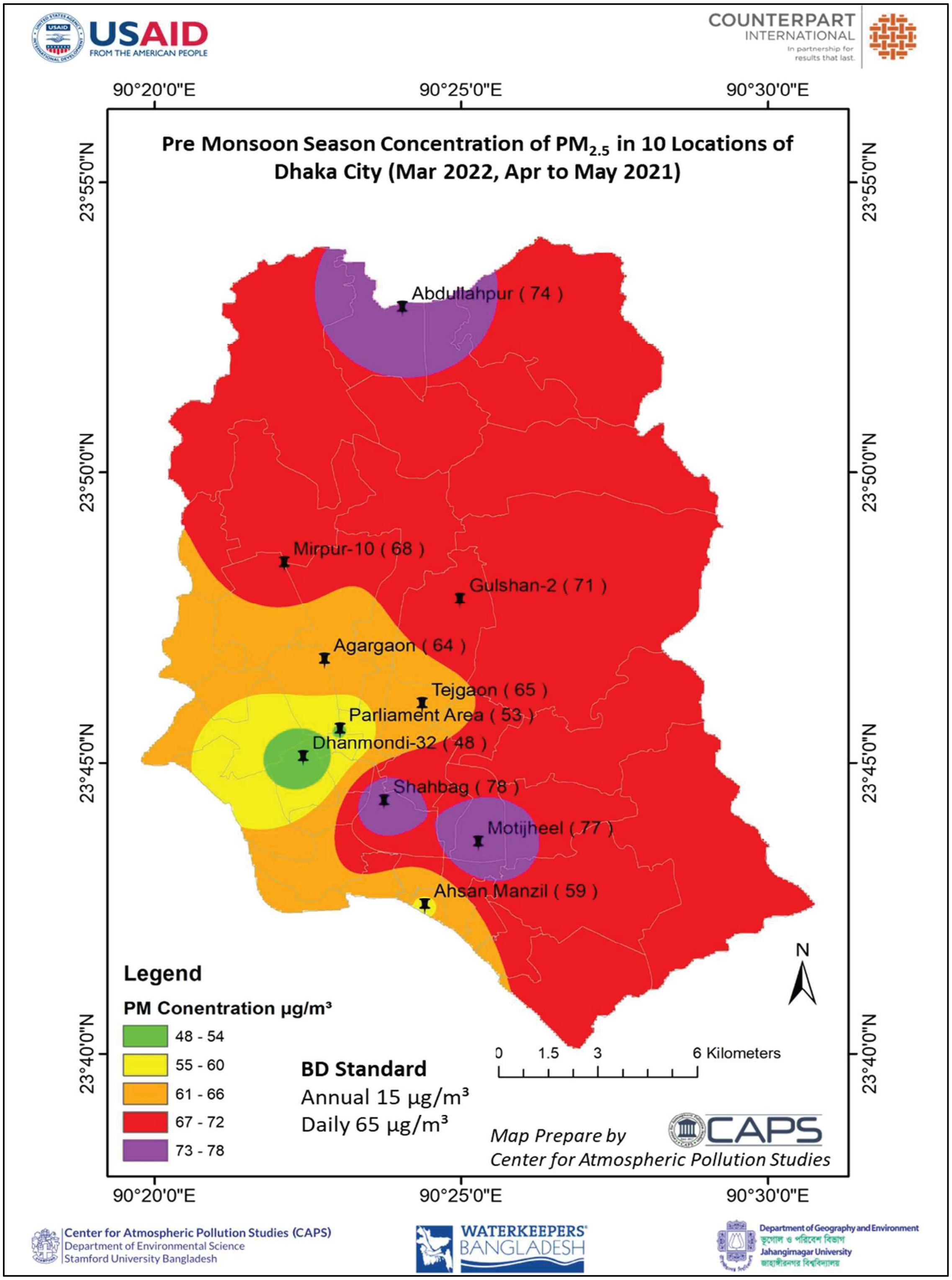


Figure 42: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City During Pre-monsoon (April to May 2021, March 2022)

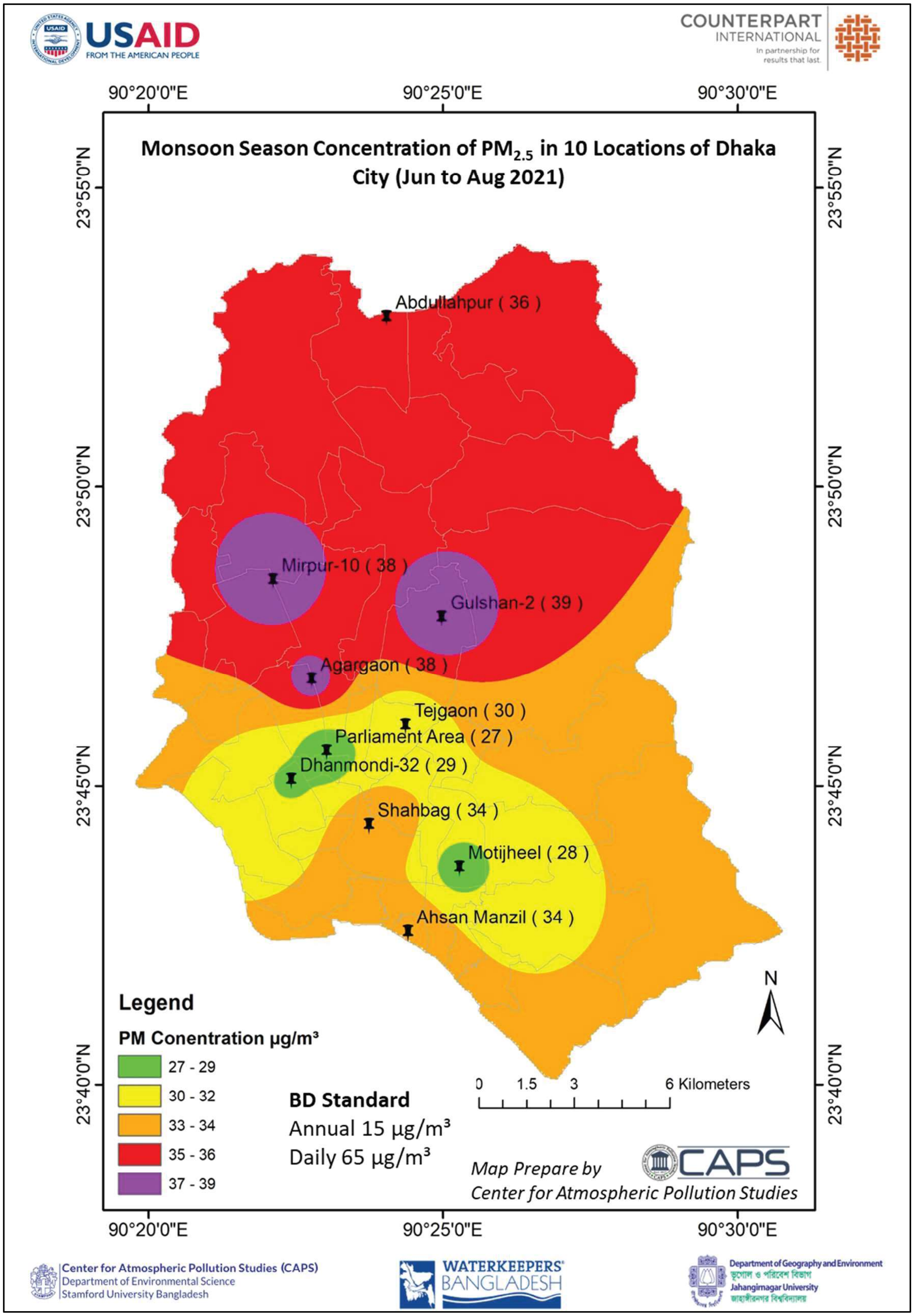


Figure 43: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City During Monsoon (June to August 2021)

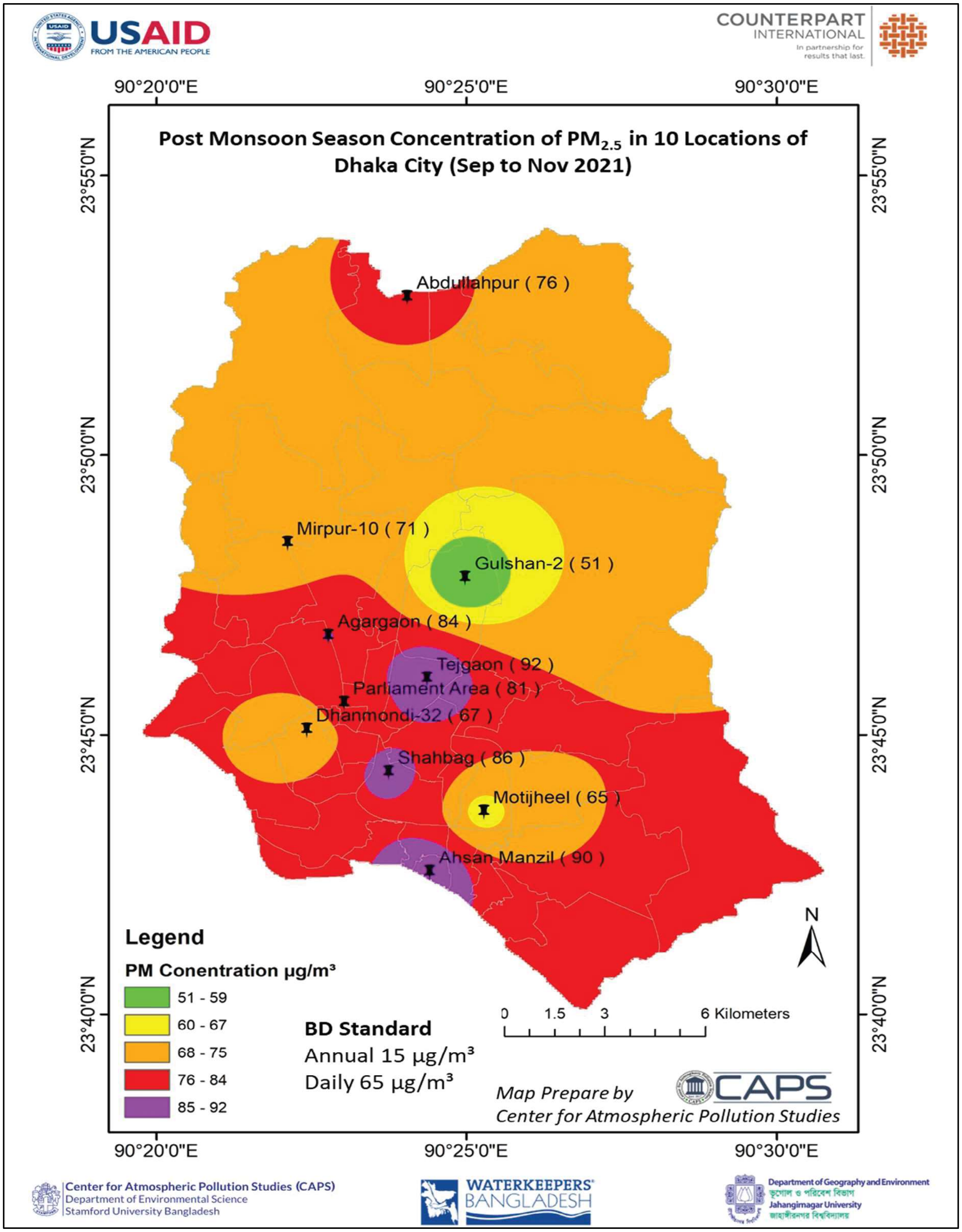


Figure 44: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City During Post Monsoon (September to November 2021)

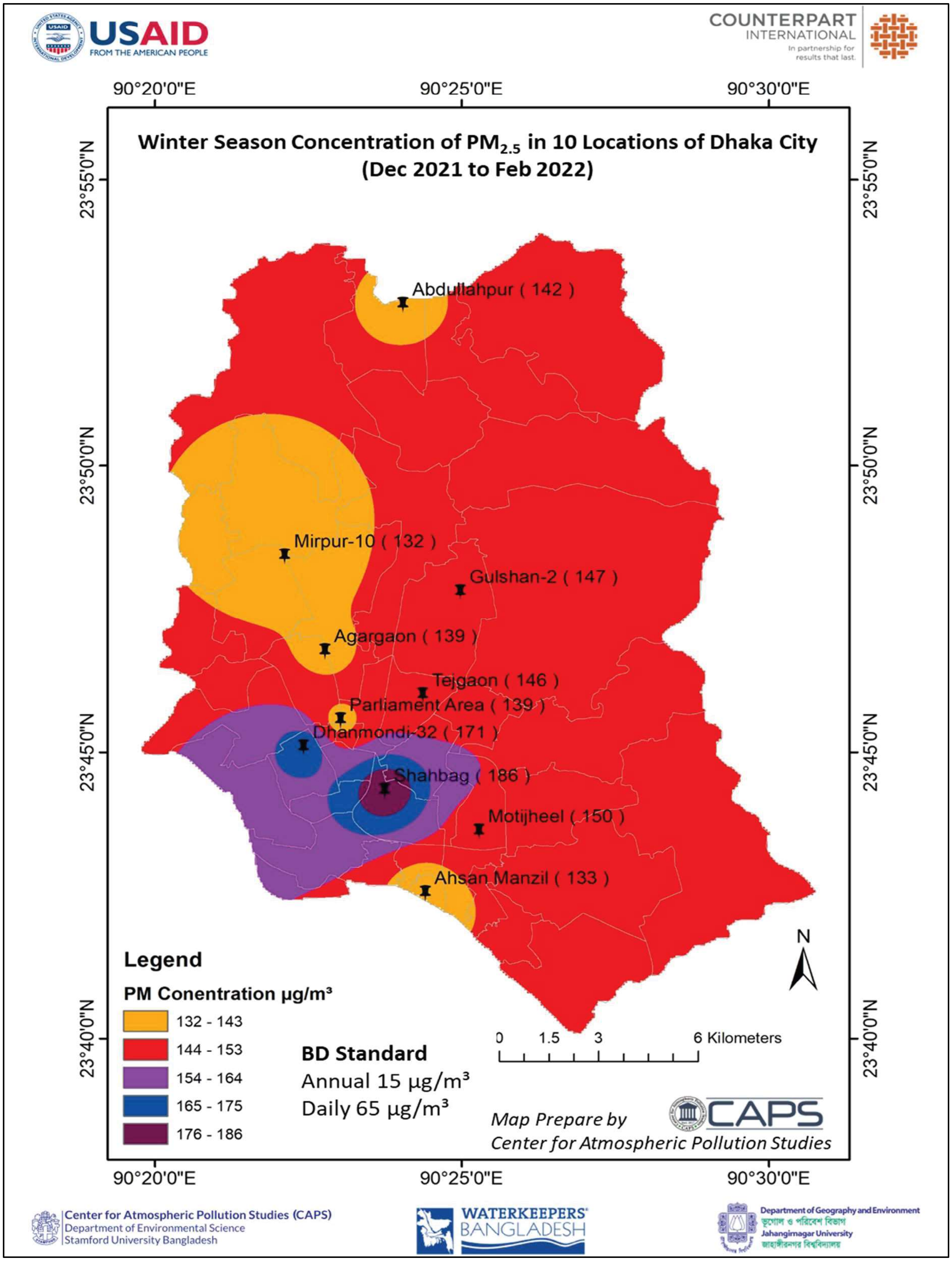


Figure 45: Seasonal Concentration of $PM_{2.5}$ in 10 Locations of Dhaka City during the Winter season (December 2021 to February 2022)

3.2.3 Status of PM_{10}

The seasonal concentration of PM_{10} over all sampling sites is shown in Table-10. During the pre-monsoon season highest mean concentration of PM_{10} was found in Mirpur-10 (139.3 µg/m³) and the lowest mean concentration was found in Dhanmondi-32 (73.9 µg/m³). The pre-monsoon seasonal mean value was 108.6 µg/m³ which is also 2.2 times higher than the annual BD standard (50 µg/m³). It has been assumed that lower concentration of particulate matter has been found in monsoon season. Comparatively lower pollution than monsoon. During monsoon highest record was found in Abdullahpur (85.8 µg/m³) and the lowest record was found in Motijheel (43.3 µg/m³). The monsoon seasonal mean value was 61.2 µg/m³, though the concentration is less but the pollution level exceeds 1.2 times compared to the annual BD Standard (50 µg/m³). Again, the pollution level of PM_{10} was increased during the post-monsoon seasonal highest observed in Agargoan (148.8 µg/m³) and lowest observed in Gulshan-2 (72.7 µg/m³) that was not in good condition. The post-monsoon seasonal mean is 111.4 µg/m³ which was 2.2 times higher than PM_{10} annual BD standard. A large concentration of PM_{10} has been found in the winter season. The seasonal mean value was 205.2 which was 4.1 times higher than the annual BD Standard (50 µg/m³). The highest record was found in Shahbag 279.9 µg/m³ and the lowest record was found in Mirpur 176.7 µg/m³ (figure-46).

Table 9: The seasonal concentration of PM_{10} over 10 locations of Dhaka city

Locations	Season Concentration (µg/m³)				Annual Mean Concentration (µg/m³)	Rank Based on Annual Concentration	Concentration Exceed BD Standard (50 µg/m³)
	Pre-monsoon (Mar, Apr, May)	Monsoon (Jun, Jul, Aug, Sep)	Post-monsoon (Oct, Nov)	Winter (Dec, Jan, Feb)			
Shahbag	130.8	65.0	140.5	279.9	147.1	1	2.9 times
Abdullahpur	137.6	85.8	116.3	209.4	130.3	2	2.6 times
Agargaon	107.0	73.2	148.8	197.3	121.3	3	2.4 times
Mirpur-10	139.3	71.8	110.2	176.7	119.0	4	2.4 times
Motijheel	112.6	46.1	90.0	193.4	109.4	5	2.2 times
Ahsan Manzil	98.8	63.8	113.5	187.9	109.1	6	2.2 times
Gulshan-2	109.9	65.5	72.7	200.4	106.1	7	2.1 times
Dhanmondi-32	73.9	43.3	91.7	224.3	102.1	8	2.0 times
Tejgaon	104.4	51.2	133.8	192.3	100.7	9	2.0 times
Parliament Area	82.5	47.3	104.4	187.2	87.6	10	1.8 times
Total Mean	108.6	61.2	111.4	205.2	112.8	-	2.3 times

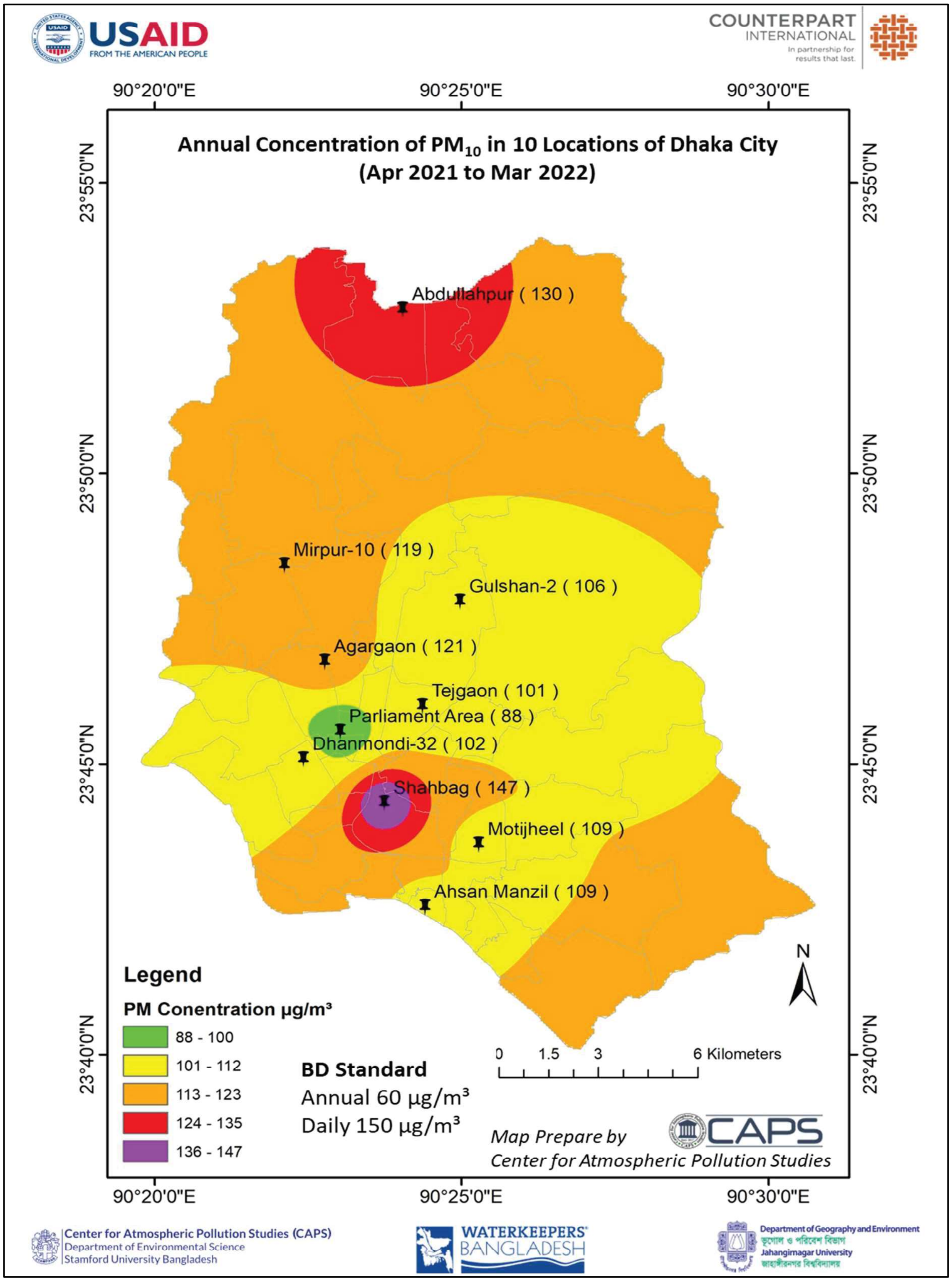


Figure 46: Annual Concentration of PM_{10} in 10 Location of Dhaka City (April 2021 to March 2022)

Among 10 locations minimum annual concentration was found 87.6 µg/m³ in the Parliament area and the maximum annual concentration of PM_{10} has been found in the 147.1 µg/m³ at Shahbag.

However, both are 1.7 and 2.9 times higher than the annual BD standard (50 µg/m³) respectively. On the other hand, the annual mean concentration of 10 locations has been found 112.8 µg/m³ which is 2.2 times higher than the standard. Among the four seasons winter is worse than the other three and comparatively monsoon seasons are best but not a single sample site concentration was found within the standard (figure-47).

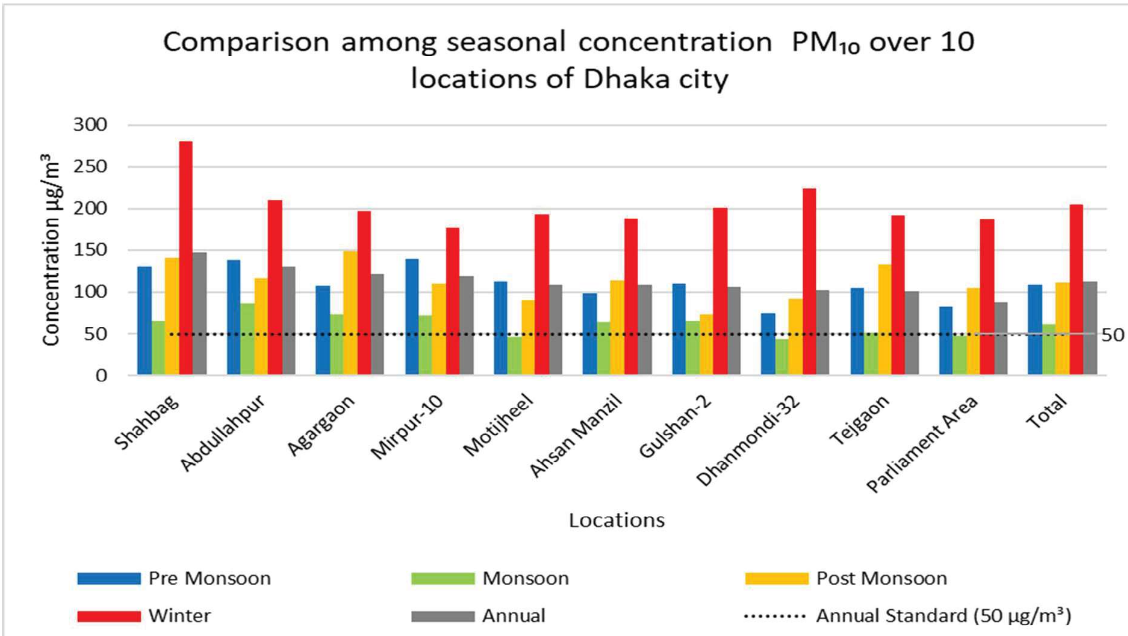


Figure 47: Comparison among seasonal concentration PM_{10} over 10 locations of Dhaka city

Furthermore, PM_{10} concentrations for all sampling sites manifested a different variation characteristic, different seasons have different hotspots of pollution (Fig. 49, 50, 51 and 52). Mirpur-10 is the pollution hotspot for pre-monsoon. Abdullahpur is the hotspot for the Monsoon season. Agargoan is the pollution hotspot for post-monsoon. Sahbag is the hotspot during the winter season. A common characteristic has been observed above mentioned hotspots that are mega projects like Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) construction activity are going on (Annex-D). Course particles like PM_{10} and other suspended particles are also found in construction areas (figure-48).

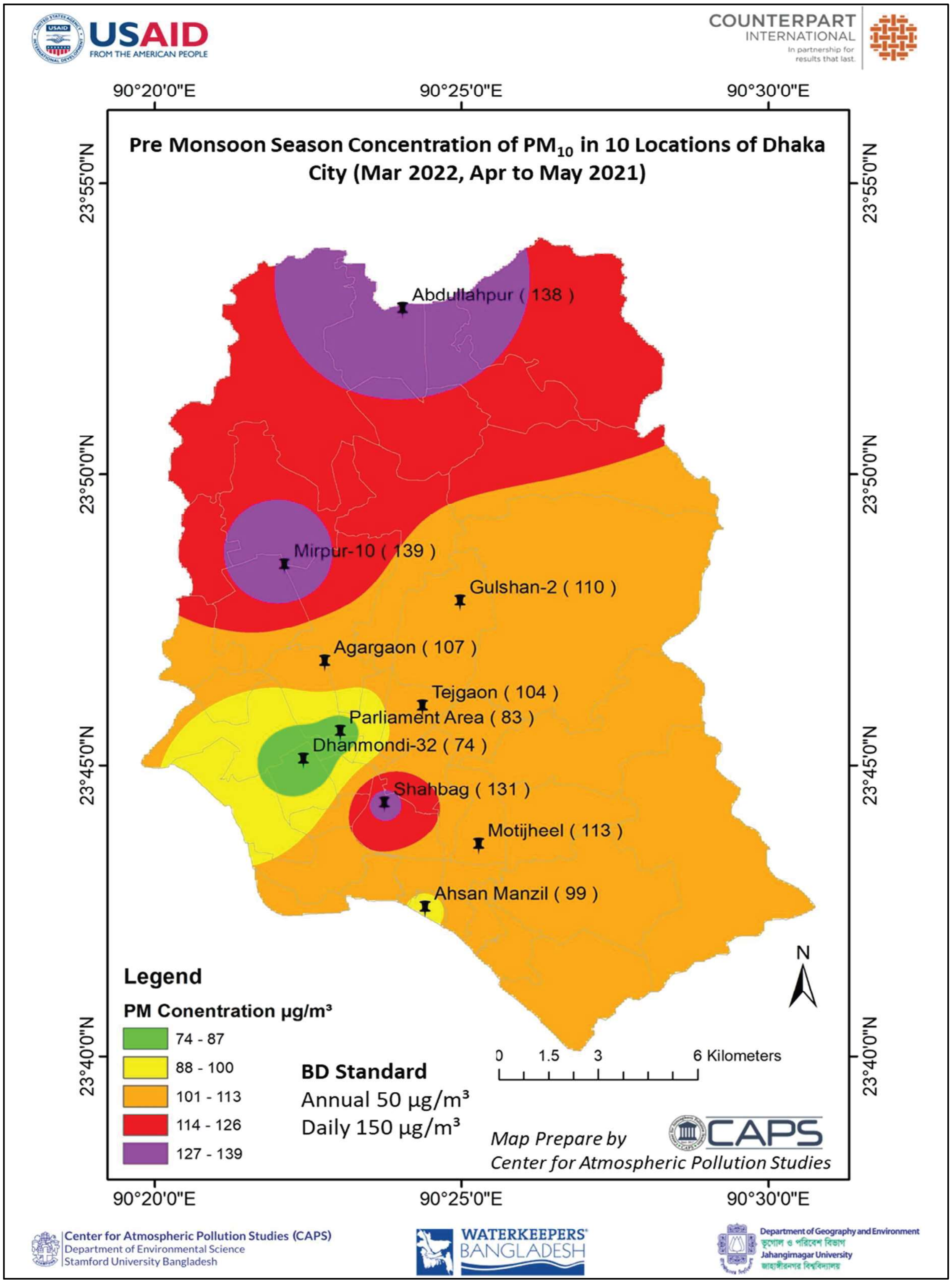


Figure 48: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Pre-monsoon (April to May 2021, March 2022)

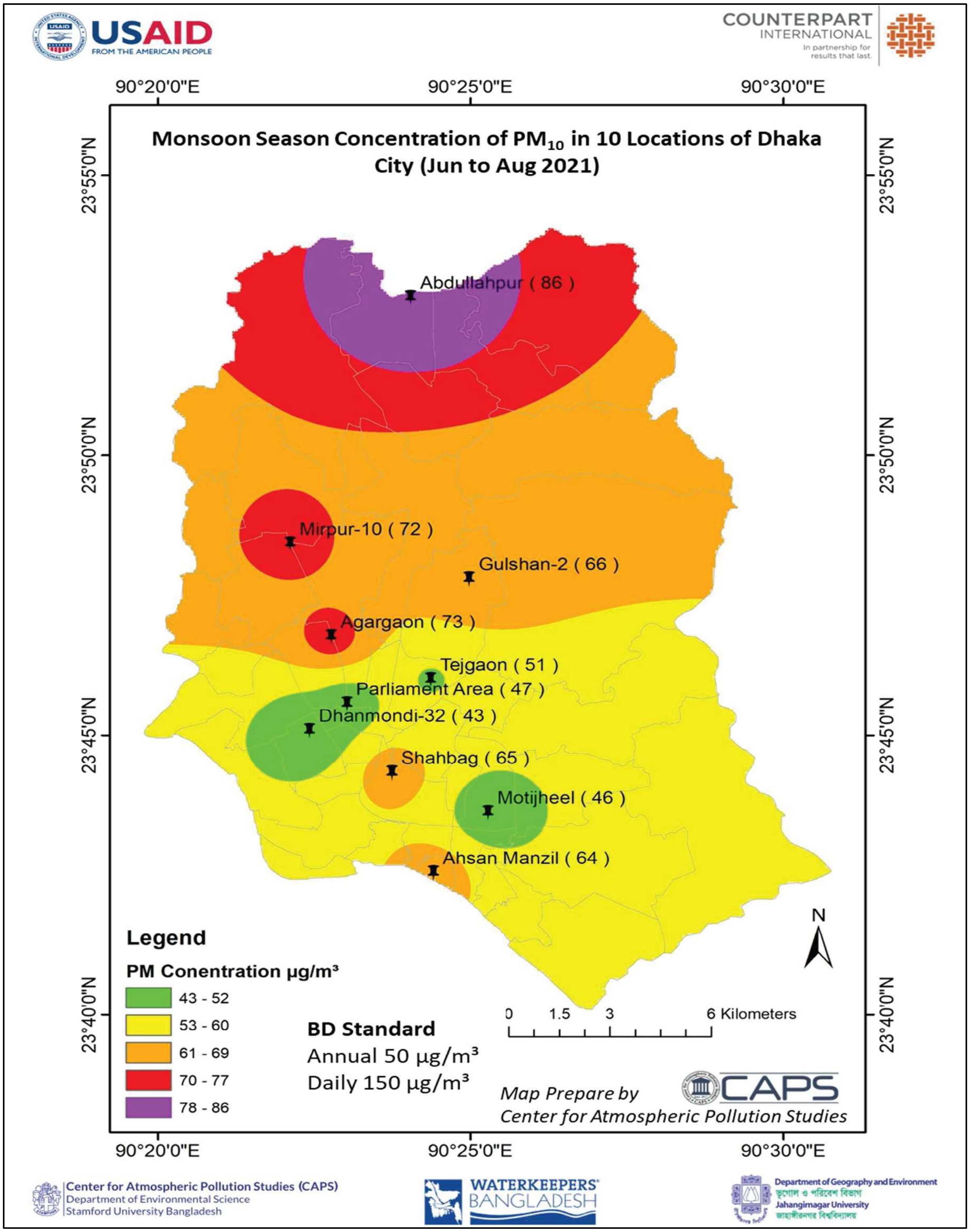


Figure 49: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Monsoon (June to August 2021)

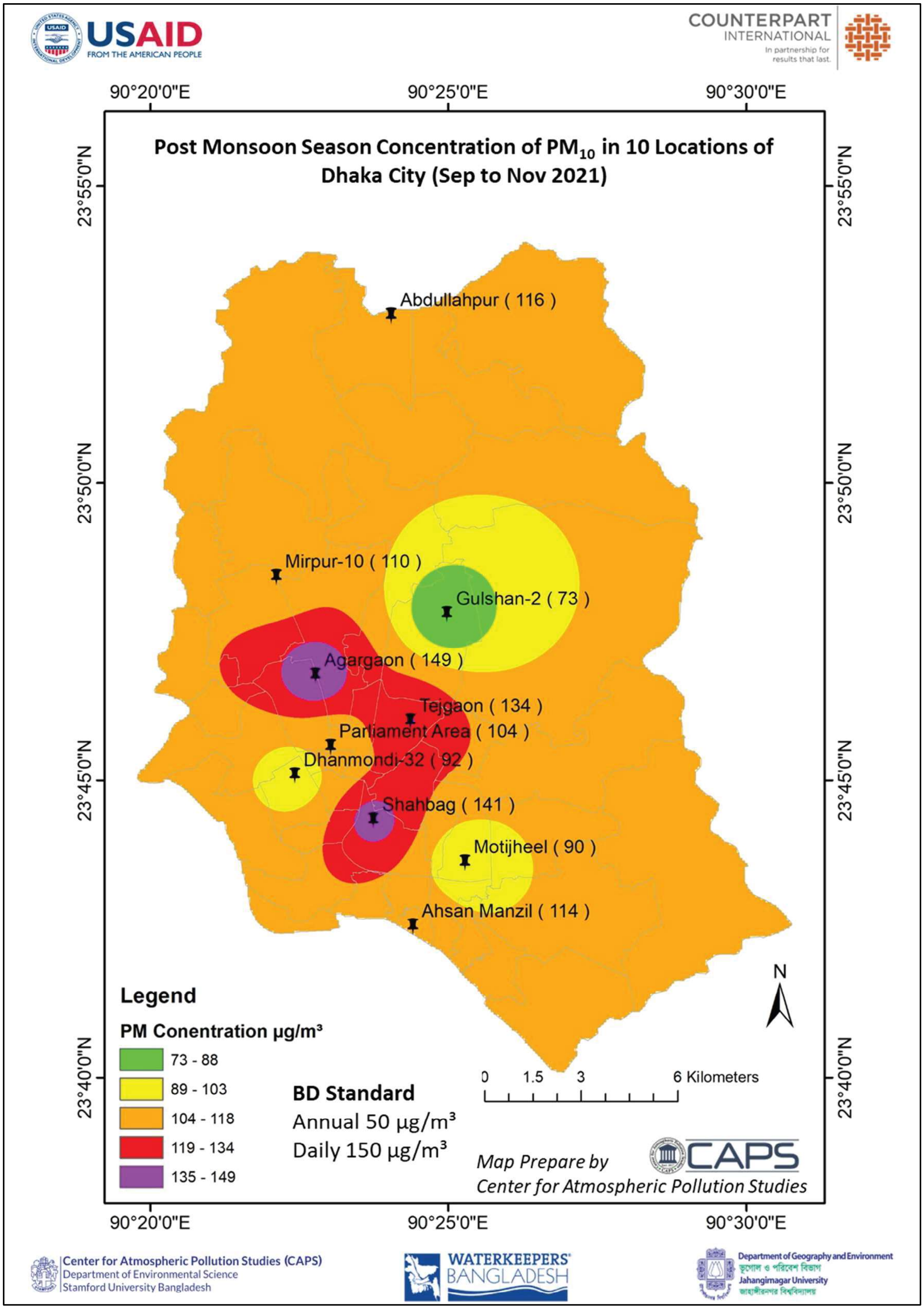


Figure 50: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Post-monsoon (September to November 2021)

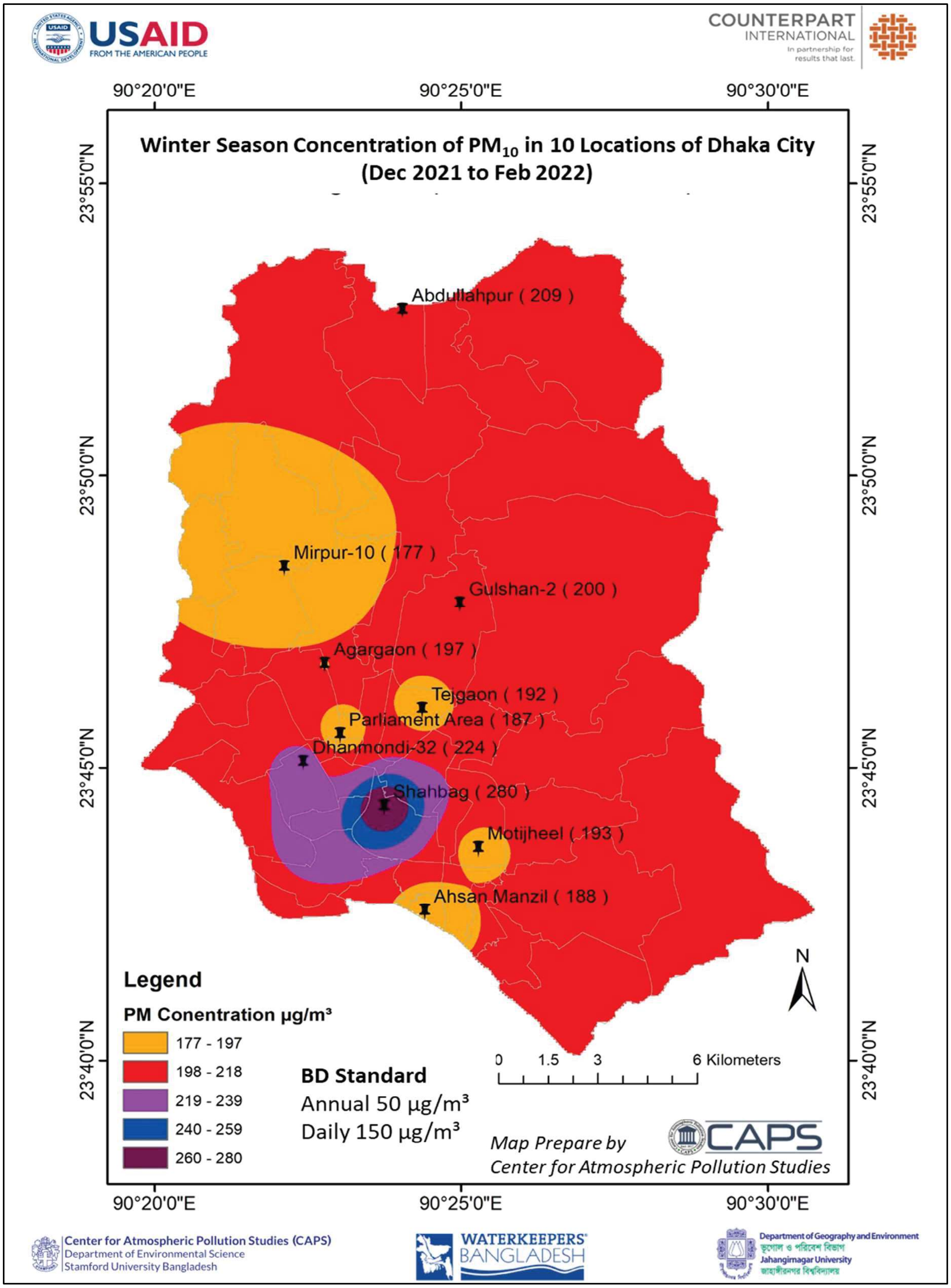


Figure 51: Seasonal Concentration of PM_{10} in 10 Locations of Dhaka City During Winter (December 2021 to February 2022)

3.2.4 Weekly Concentration of $PM_{2.5}$ and PM_{10}

Figure-52 showed the weekly concentration of $PM_{2.5}$ and PM_{10}. The day analysis comparison study found the average mean concentration of $PM_{2.5}$ maximum on Thursday (76.9 µg/m³) followed by Saturday (76.2 µg/m³), Sunday (74.7 µg/m³) and Tuesday (75.1 µg/m³) where minimum mean concentration on Friday (65.2 µg/m³). Again, we could see that the mean concentration is max on Sunday (121.8 µg/m³) followed by Thursday (113.4 µg/m³) then Saturday (111.7 µg/m³) min found on Friday (103.8 µg/m³). It is expected that local transport services could be reduced on weekends (Friday and Saturday), but textile shipment delivery trailer trucks were reported to be a max on Friday (Hoque et al., 2013; Khan and Hoque, 2013), which could compensate for expected reductions in local commuter emissions on Friday, which is a religious observance day of the week in Dhaka it may another reason of less pollution.

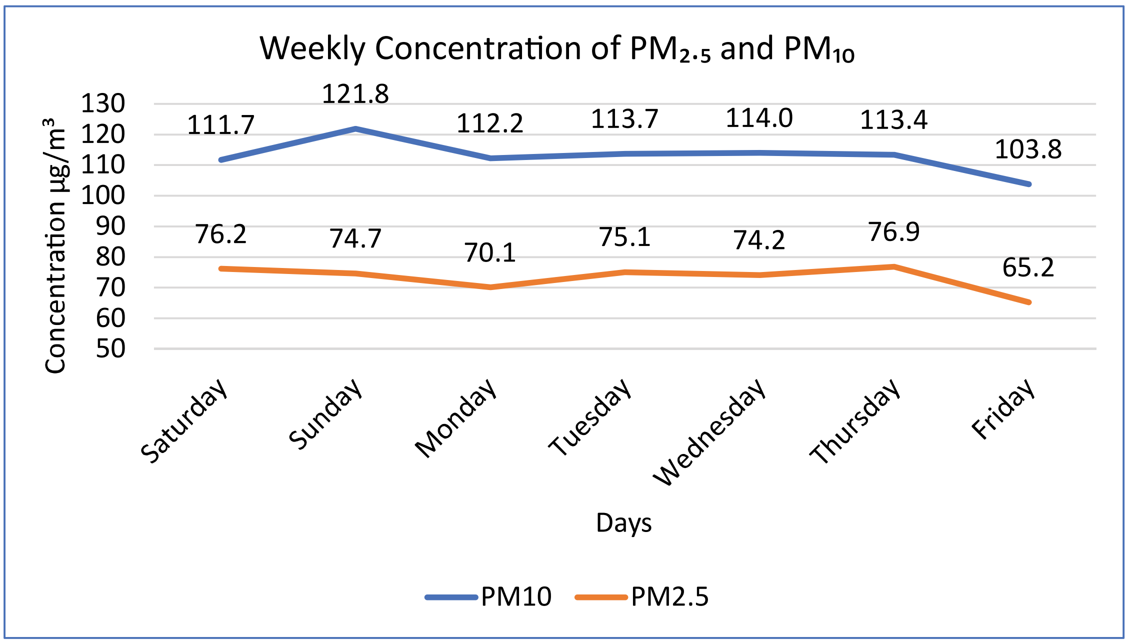


Figure 52: Weekly Concentration of $PM_{2.5}$ and PM_{10}

3.2.5 Ratio of $PM_{2.5}$ and PM_{10}

Figure-53 estimated that in all locations, an average of 67.36% of $PM_{2.5}$ was present in PM_{10}. The study characterizes $PM_{2.5}/PM_{10}$ ratio estimated in Ahsan Manzil was 67.50%, Motijheel was 71.86%, Shahbag was 66.73%, Dhanmondi was 72.90%, Parliament area was 67.43%, Tejgaon was 67.69%, Agargaon was 64.17%, Mirpur-10 was 64.50%, Gulshan-2 was 66.44%,Abdullahpur was 64.72%. Begum et al., 2004 reported that fine particles ($PM_{2.5}$) produce more than coarse ones ($PM_{2.5}$-10 particles) which mostly originate from mechanical processes from vehicles emission.

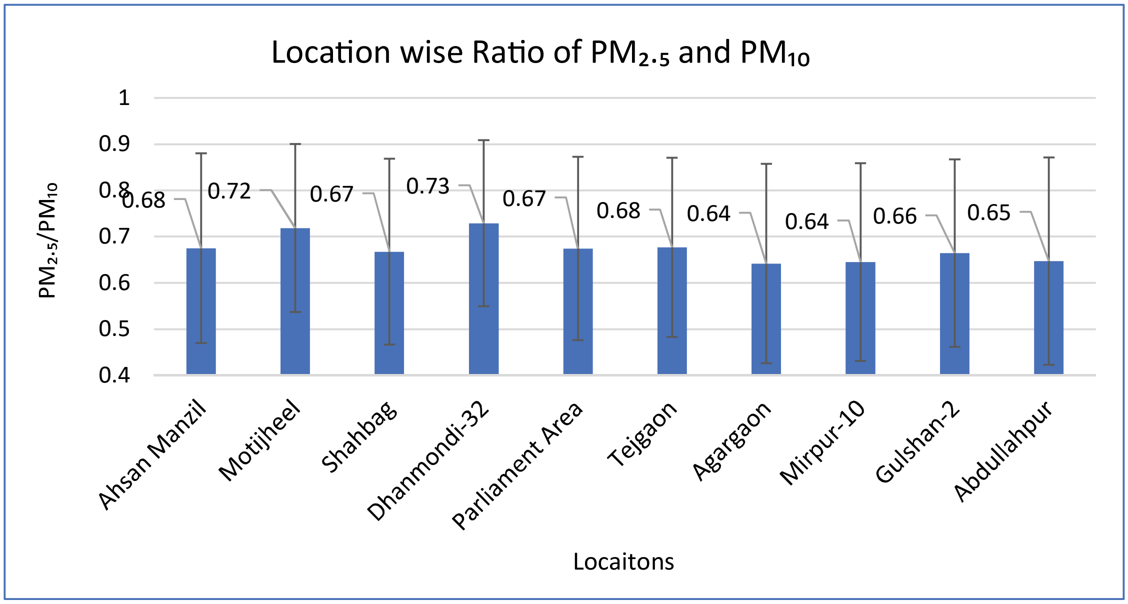


Figure 53: Location wise Ratio of $PM_{2.5}$ and PM_{10}

The ratio changed in different seasons (figure-54). The average ratio has been found for all seasons is 67.36%, the highest ratio found in winter, followed by post-monsoon, pre-monsoon and least ratio found in monsoon. The quantity of PM decreases in summer reaching its lowest level in July, however, it increases significantly in the winter season, and average concentrations of PM_{10} and $PM_{2.5}$ at the city Dhaka surpasses (Hossain et al., 2019). Its two neighbours Manikganj and Nawabganj, $PM_{2.5}$ /PM_{10} ratio is higher in the sub-urban areas than in urban areas and for all the sites $PM_{2.5}$ is approximately twice than that of WHO and USEPA.

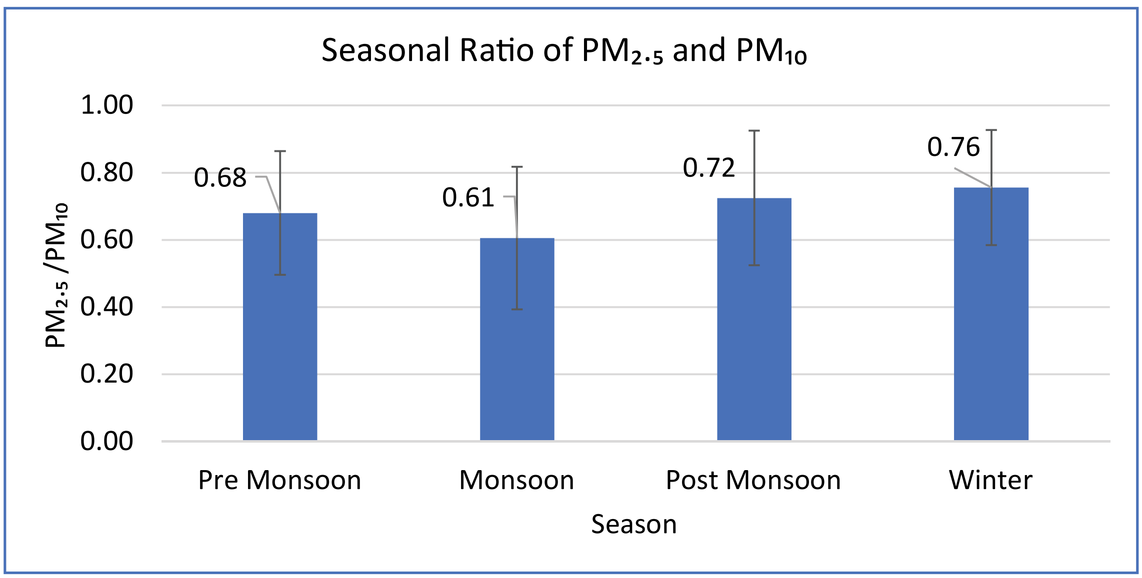


Figure 54: Seasonal Ratio of $PM_{2.5}$ and PM_{10}

Again Begum et al., (2011) showed that the ratio of $PM_{2.5}$ /PM_{10} showed that the average $PM_{2.5}$ mass was about 78% of the PM_{10} mass. Hossain et al., (2019) revealed a comparison of atmospheric particulate matter (PM) of a highly polluted Dhaka.

3.2.6 Diurnal Concentration of $PM_{2.5}$ and PM_{10}

In figure-55 illustrate that the peak $PM_{2.5}$ and PM_{10} concentrations (77.0128 and 112.78 µg/m3) were observed in the evening, between 6 pm to 12 pm. Shifting-wise variations are governed by interplays among pollution sources, photochemical processes, and weather factors. High pollution concentrations measured during nighttime could result from the local rules on traffic flow in Dhaka (as the diesel-powered buses and freight trucks can use Dhaka city route only at nighttime (between 6 pm-12 am), low mixing height during nighttime (Rahman, 2018; Begum et al., 2011). Long-route buses and any kind of heavy-duty diesel trucks are barred from using any highway inside Dhaka during the daytime (DTCB, 2011). The concentration of $PM_{2.5}$ and PM_{10} are almost the same in the morning (67.45 and 105.93 µg/m3) and afternoon (71.90 and 113.91 µg/m3), where it gets higher during the afternoon and reach highest at night.

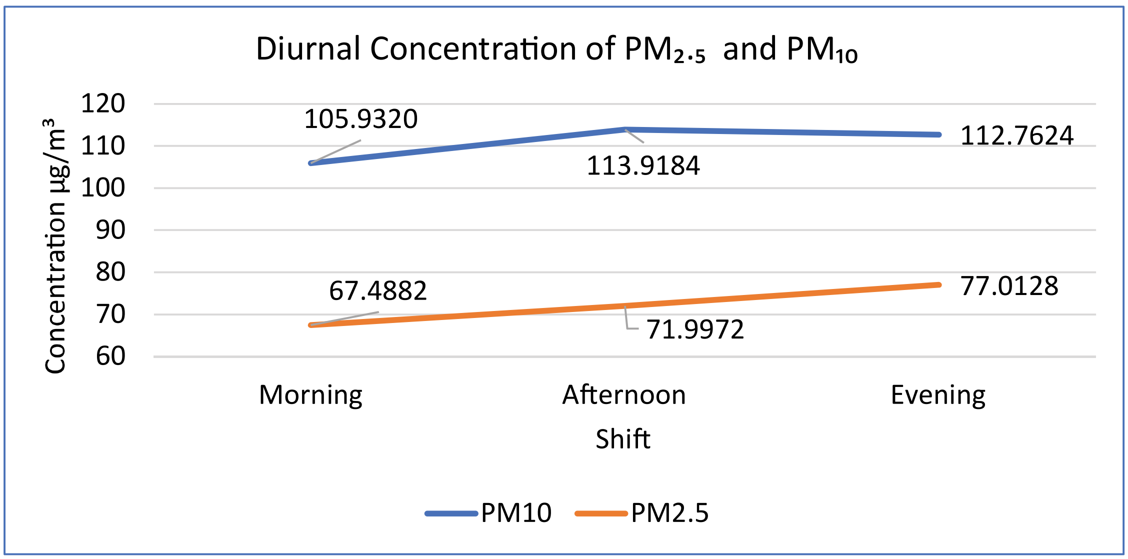


Figure 55: Diurnal Concentration of $PM_{2.5}$ and PM_{10}

3.2.7 Monthly Concentration of $PM_{2.5}$ and PM_{10}

Figure-56 reveals that the monthly average means $PM_{2.5}$ and PM_{10} concentration was found the highest in January (174.9 and 240.5 µg/m³ respectively), the mean concentration of $PM_{2.5}$ and PM_{10} has been 25.5 and 48.4 µg/m³ which was the lowest in comparison to the rest of the months.

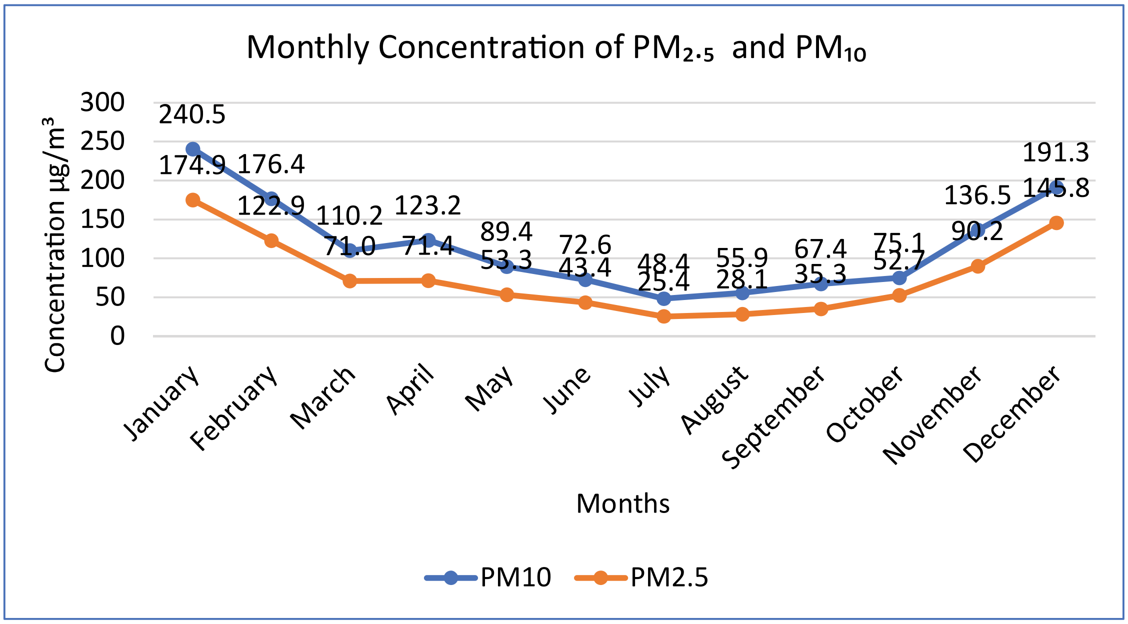


Figure 56: Monthly Concentration of $PM_{2.5}$ and PM_{10}

During December, January and February have maintained an average mean of above 122 µg/m³ for $PM_{2.5}$ and 176 µg/m³ for PM_{10} respectively. The trend shows a rise in the average mean concentration from July to December and January to February then again, a downfall from January to June and July. The breakdown from March is noticeable when the concentration falls (71.4 and 123.2 µg/m³ respectively). This is because December to February is in the winter season and during this time there is a rise in the level of emission and the lower-mixing layer height in addition to thermal inversion in the brick kilns industry. This expands the amount of particular matter (Rahman et al., 2020 and Nayeem et al., 2020). Brick kilns are one of the industries that operate only during the drier season and not during the monsoon, therefore, in months like June and July there are fewer activities within those industries, less emission and thus, lower concentration. High concentration of $PM_{2.5}$ and PM_{10} during the winter season is caused by the seasonal fluctuations of the emissions as well as by the meteorological effects (Begum and Hopke 2018).

3.2.8 Cluster Analysis

Figure-57 shows the dendrogram plot obtained from cluster analysis in terms of $PM_{2.5}$ and PM_{10} with Z-score normalization. For this analysis, the average linkage between groups has been considered. At the very primary level, three clusters have been found from the below $PM_{2.5}$ graph. In the $PM_{2.5}$ graph, the first cluster is consisting of Ahsan Manzil, Gulshan-2, Abdullahpur, Dhanmondi-32, Mirpur-10, Agargaon, Tejgaon and Motijheel which are joined with the second cluster Parliament Area at the approximate distance of 13. These clusters joined with the third Cluster including Shahbag Area at an approximate distance of 25. Again, for the PM_{10} graph, the fourth cluster has been found, the first cluster is consisting of Ahsan Manzil, Motijheel, Gulshan-2, Dhanmondi-32, Tejgaon, which joint with the second cluster Parliament Area at the approximate distance of 6. These clusters joined with the third cluster composed of Agargaon, Mirpur-10 and Abdullahpur at the approximate distance of 9 which again joins with the fourth cluster that involves Shahbag at the approximate distance of 25.

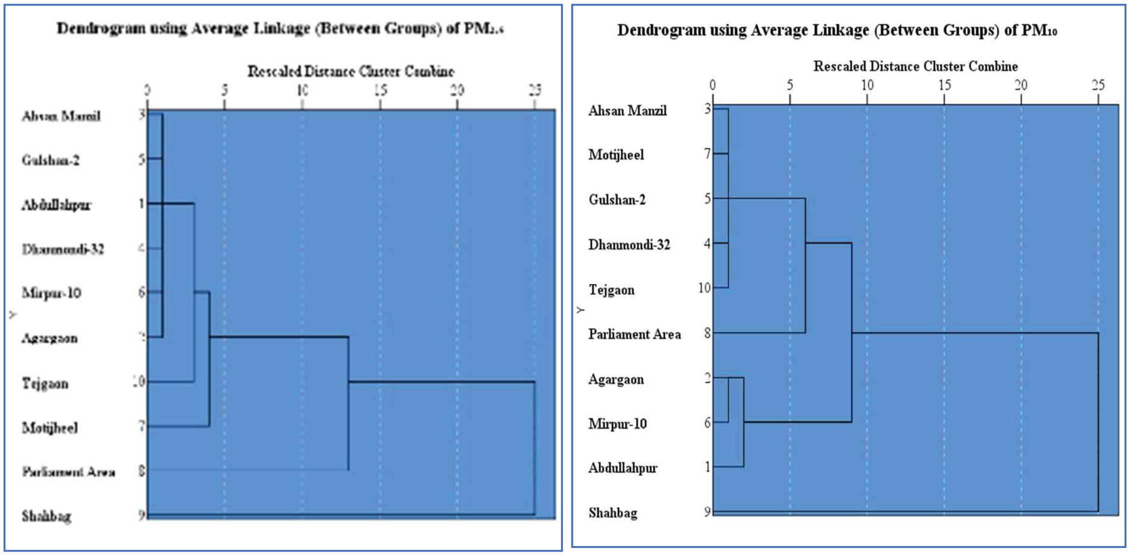


Figure 57: Dendrogram using averaging linkage (between group) of PM2.5 (a) and PM10 (b)

3.2.9 Correlation Among $PM_{2.5}$ and PM_{10}

Table-9 represents that there is a negative pearson correlation between $PM_{2.5}$ and PM_{10} and the meteorological parameters (Precipitation, Humidity, Wind and Temperature). Specifically, $PM_{2.5}$ and PM_{10} have a significantly inverse correlation (r=-0.831 and -0.776 respectively) with temperature across the years. When there is high temperature causes the atmospheric pressure to be low and there is atmospheric instability which helps pollutant dispersion over a large area and reduces concentration (Hoque et. al., 2020). The correlation between the Particulates Matters ($PM_{2.5}$ and PM_{10}) and precipitation, is negative, however, it is not consistently significant (r= -0.665 and -0.664 respectively). Precipitation is known to reduce $PM_{2.5}$ and PM_{10} load through wet deposition (Hoque et. al., 2020). Relative humidity and windspeed are also inversely correlated (r= -0.265, and -0.578 respectively) to $PM_{2.5}$. Relative humidity influences particle movement since it can make the particulate matter to settle down at the ground, lowering their concentration (Kayes et al., 2019).

Table 10: Correlation Among $PM_{2.5}$ and PM_{10} and selected meteorological parameters

		PM_10	PM_2.5	Precipitation	Humidity	Wind	Temperature
PM_10	Pearson Correlation	1	.968**	-.655**	-.301**	-.551**	-.776**
	Sig. (1-tailed)		.000	.000	.000	.000	.000
	N	120	120	120	120	120	120
PM_2.5	Pearson Correlation	.968**	1	-.664**	-.265**	-.578**	-.831**
	Sig. (1-tailed)	.000		.000	.002	.000	.000
	N	120	120	120	120	120	120
Precipitation	Pearson Correlation	-.655**	-.664**	1	.658**	.768**	.602**
	Sig. (1-tailed)	.000	.000		.000	.000	.000
	N	120	120	120	120	120	120
Humidity	Pearson Correlation	-.301**	-.265**	.658**	1	.204*	-.006
	Sig. (1-tailed)	.000	.002	.000		.013	.475
	N	120	120	120	120	120	120
Wind	Pearson Correlation	-.551**	-.578**	.768**	.204*	1	.629**
	Sig. (1-tailed)	.000	.000	.000	.013		.000
	N	120	120	120	120	120	120
Temperature	Pearson Correlation	-.776**	-.831**	.602**	-.006	.629**	1
	Sig. (1-tailed)	.000	.000	.000	.475	.000	
	N	120	120	120	120	120	120

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Figure-58 shows there is a relationship between $PM_{2.5}$ and PM_{10}. Nature of the relationship is strongly positive, and correlation is significant at the 0.01 level. R^2 value is 0.658.

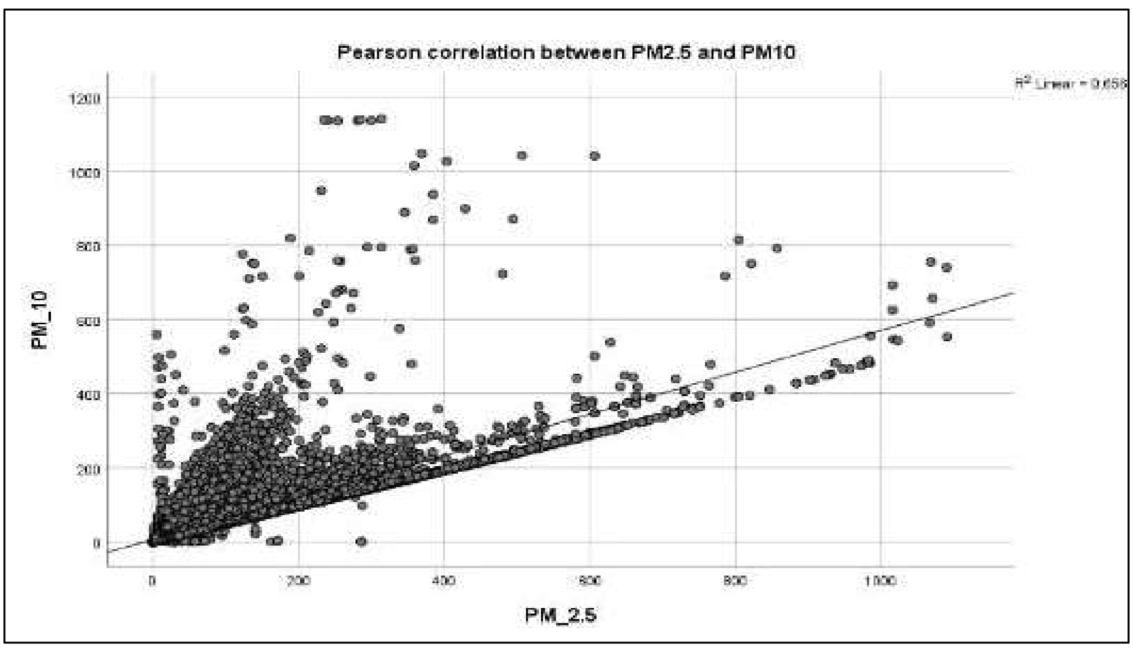


Figure 58: Pearson correlation between PM2.5 and PM10

3.2.10 Correlation between US Embassy Dhaka, CAPS-USAID Project data

Figure-59 shows that the correlation between the US Embassy Dhaka, CAPS-USAID Project annual data of $PM_{2.5}$ is strong. The r^2 value is 0.7267 which means a high level of correlation between two types of data. This study found annual (April-21 to March-22) concentration of $PM_{2.5}$ is 73.1 µg/m³ which is 4.9 times higher than BD annual standard (15 µg/m³). Where data was acquired by the U.S. Embassy, Dhaka website annual (April-21 to March-22) concentration of $PM_{2.5}$ is 91.07 which is 6 times higher than BD annual standard (15 µg/m³).

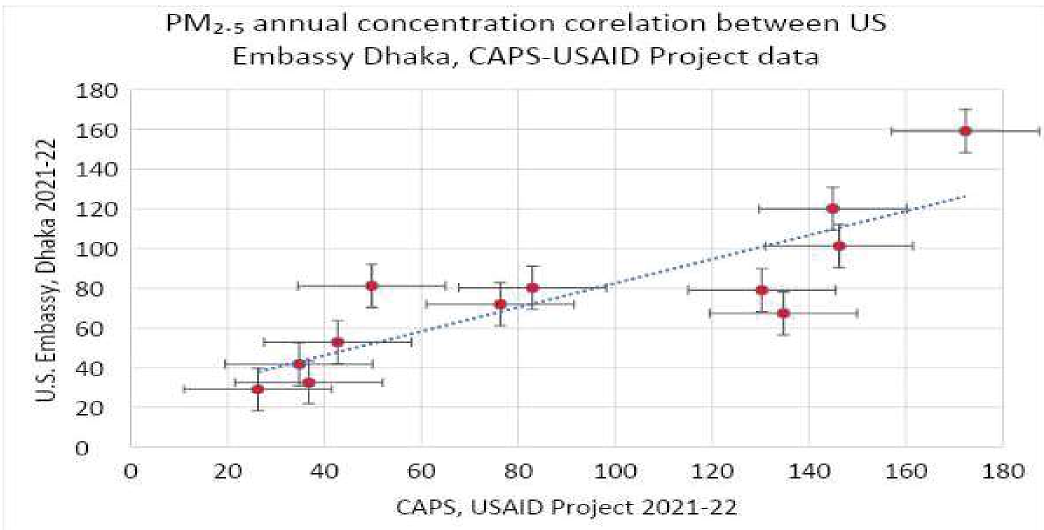


Figure 59: Correlation between US Embassy Dhaka, CAPS-USAID Project data

3.3 Status of Noise

The subsequent table-10 and 11 presents the Land use and shift-wise Noise level exposure time in Dhaka from April 2021 to March 2022. The collected data represent and comply with 5 land use noise standard level categories in Sound Pollution (Control) Act, 2006 and are considered safe sound levels by the U.S. Department of Health & Human Services.

The standard value for Silent Area is 50 dB in contrast, the three locations; Ahsan Manzil, Parliament Area, and Shahbag averaged 96.7% of the time exceeding the BD standard. Dhanmondi-32 and Gulshan-2 are categorized as residential areas in this study, the approved noise level is 55dB where 91.2% time exceeded the BD standard. The mixed area noise level standard is 60dB, this study selected Agargaon and Abdullahpur as mixed areas, in these two locations 83.2% of the time exceed the BD standard. Mirpur-10 and Motijheel as selected as commercial areas, the noise level approved for this location is 70dB in this contrast the noise level exceeds 61%. Tejgaon is the only the industrial area of this study, for the industrial area 75dB is the max limit for noise, hence 18.2% of the time exceeds the BD standard.

As whole Dhaka city is considered a mixed area, 60dBA is the standard limit for daytime. An average of 81.7% of the time noise level exceeds the standard limit. Ranking based on 60dB Agargoan is the top noise polluted location here noise level exceeds 87.9% of the time. And least noise polluted location is Tejgaon where the noise level exceeds 73.6% of the time. The difference between the highest and lowest polluted locations is not much more. Sounds at or below 70 dBA are generally considered safe by the U.S. Department of Health & Human Services. Analysis of data obtained from 10 places in Dhaka compared with 70 dB shows that 50.2%-time noise level exceeds.

Table 11: Equivalent noise level (Leq) and Ln value of Noise

Land Use & BD Standard (Day)	Location	Leq day in B(A)	Rank Based on Leq	Max dB(A)	Min dB(A)	L10 dB(A)	L50 dB(A)	L90 dB(A)
Silent Area (50 dB)	Ahsan Manzil	95.04	3	131.5	37.3	83.4	68.9	55.2
	Parliament Area	93.5	6	131.1	31.7	82.9	70.3	55.3
	Shahbag	92.8	7	133.0	35.7	83.6	71.0	57.6
Residential Area (55 dB)	Dhanmondi-32	92.7	8	131.5	35.7	82.7	68.2	56.0
	Gulshan-2	95.44	1	131.9	39.3	83.9	68.7	55.7
Mixed Area (60 dB)	Agargaon	91.3	9	131.4	36.6	82.7	70.7	59.1
	Abdullahpur	95.43	2	131.3	35.5	85.9	71.6	54.1
Commercial Area (70 dB)	Mirpur-10	94.97	4	130.5	34.4	87.7	74.4	57.2
	Motijheel	93.57	5	130.2	38.1	84.5	72.3	58.2
Industrial Area (75 dB)	Tejgaon	89.14	10	130.2	37.7	78.9	65.9	53.9
Average		93.39				83.62	70.2	56.23

Table 12: Land use and Shift wise Noise level exposure (%) in Dhaka for the Month of April 2021 to March 2022.

Land Use & BD Standard (Day)	Locations Name	% of Time Exceeded Bangladesh Standard (Morning)	% of Time Exceeded Bangladesh Standard (Afternoon)	% of Time Exceeded Bangladesh Standard (Evening)	% of Time Exceeded Bangladesh Standard (Total)	% of Time Exceeded BD Standard (Land use Wise)	% of Time Within BD Standard (Land use Wise)	% of Time Exceeded 70dB **	% of Time Exceeded Mixed Area Standard 60dB *	Ranking based on Mixed area Noise Level
Silent Area (50 dB)***	Ahsan Manzil	95.3	97.4	95.8	96.7	96.7	3.3	46.1	77.8	9
	Parliament Area	93.3	96	96.8	95.9			51	81.7	5
	Shahbag	99.1	98	95.1	97.5			53.7	85.7	3
Residential Area (55 dB)***	Dhanmondi-32	95.3	92.6	85.3	91.2	91.2	8.8	43.2	80.6	6
	Gulshan-2	97	91.6	89.6	91.2			45.5	78.7	8
Mixed Area (60 dB)***	Agargaon	96.7	88.1	84.1	87.9	83.2	16.8	53.3	87.9	1
	Abdullahpur	73.7	81.1	75.1	79.4			54.3	79.4	7
Commercial Area (70 dB)***	Mirpur-10	70.8	69.8	49.9	62.3	61	39	62.3	85	4
	Motijheel	58.1	59.5	58.4	59			59	86.4	2
Industrial Area (75 dB)***	Tejgaon	17.7	16.1	24.8	18.2	18.2	81.8	33.3	73.6	10
					Total	70	30	50.2	81.7	-

Note:
* If whole Dhaka city consider as Mixed area, 60dBA is standard limit for daytime.
** Sounds at or below 70 dBA are generally considered safe (U.S. Department of Health & Human Services)
*** Standard for noise level in daytime according to Bangladesh Noise Pollution (Control) Rules 2006

Table-10 shows that the max noise range is 130.2 dB to 133 dB and the min noise range is 31.7 dB to 39.3 dB for all 10 locations of Dhaka city. Equivalent noise level (Leq) analysis shows that Gulshan-2 (95.44 dB) is the top noise polluted area of Dhaka city whereas Tejgaon (89.14 dB) is the less noise polluted area, though is less among 10 locations but its Leq is too much high. Table 11 clearly shows that high traffic noise (L10) was noted with the evaluated range of 78.9-87.7 dBA. The background noise (L90) is lower with the calculated values ranging from 53.9-59.1 dBA. Mid-level noise (L50) calculated values ranged from 65.9-74.4 dBA.

The Spatial Noise Level in 10 Locations in Dhaka (figure-60) shows the mean noise level at different places in Dhaka city. Green area is less noise level, and yellow areas have limited use while rising to higher levels, as shown in orange and red. The noise was found to have the highest Leq at Gulshan-2 which is 95.44 dBA, and the lowest Leq noise level identified in the area of Tejgaon 89.14 dBA. Among 10 locations over 1 year of sampling time, the maximum sound level was found in the Shahbag area at 133 dBA and the lowest minimum despite at Parliament Area at 31.7 dBA. At US Environmental Protect Agency Noise Categories Spatial Noise Level in 10 Locations of Dhaka, 2021 Map named "Leqday in dB(A) of Dhaka City- 2021" categories the area as per Annon. EPA, Pollution 2014, The noise value 65- 69 dBA - Highly risky, 70- 74 dBA – Dangerous, 75-79 dBA- Highly Dangerous and >80 Extremely Dangerous. Table-10 Leq in dB(A) shows that 100% of the area (10 locations) is situated in an Extremely Dangerous zone. Though the map shows different color for better understanding, the Leq value of noise level in the map starts from 89.14 dBA and end at 95.44 dBA.

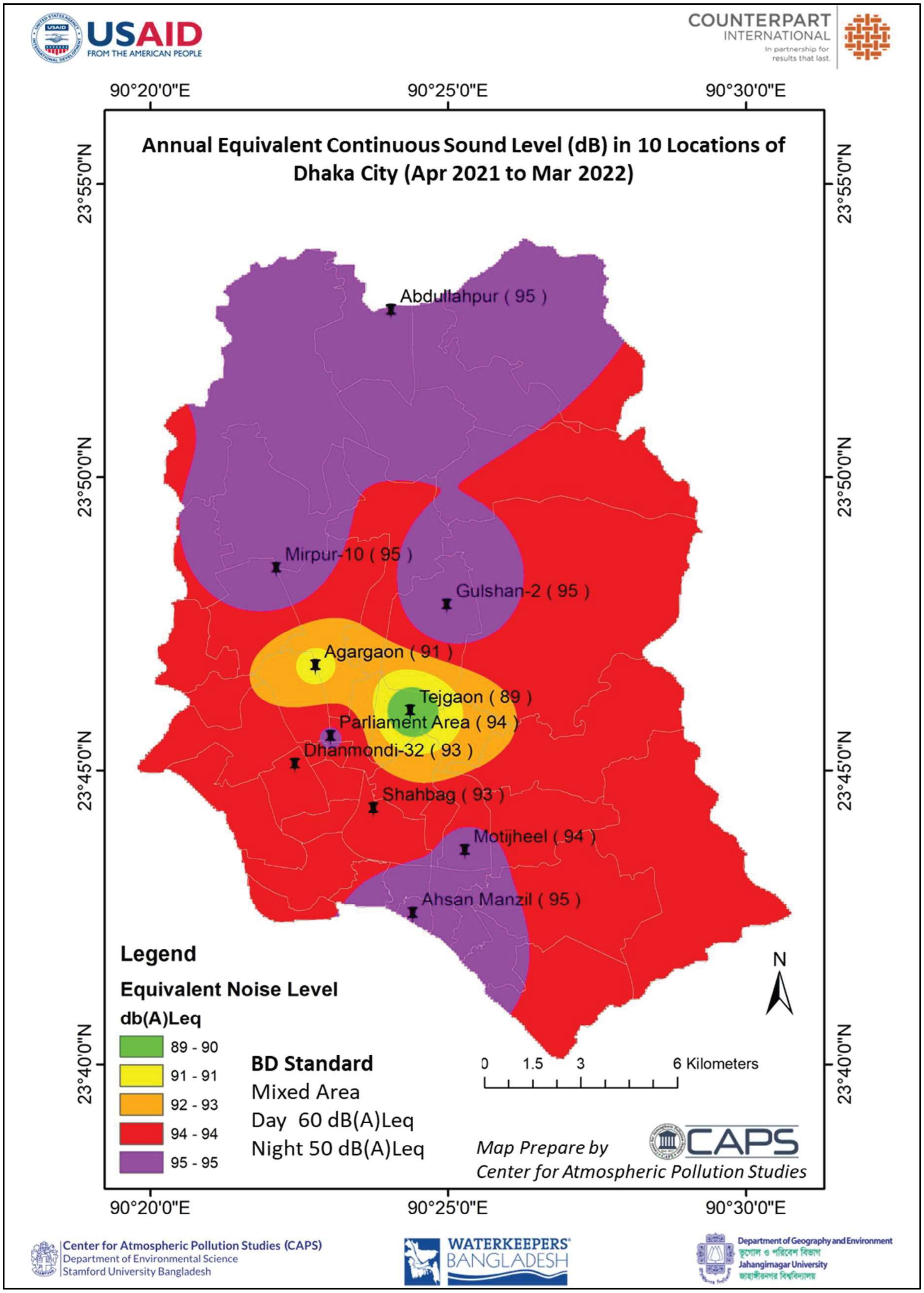


Figure 60: Annual Equivalent Continuous Sound Level in 10 Location of Dhaka city (April 2021 to March 22)

The discussion above clearly shows that pollution in Dhaka has become a serious issue, which is an alarming sign. The river water is no longer usable, and the level of particulate matter is high, indicating an urgent need to address the problem.

The next chapter will explore the community and civil society's perceptions of water pollution, which may help us align scientific evidence with public opinion.

CHAPTER FOUR: CIVIL SOCIETY AND COMMUNITY PERCEPTION

Organisations not affiliated with the government make up civil society, including educational institutions, religious institutions, professional organisations, and advocacy groups (business platforms are sometimes may considered as CSO). Organisations in CS serve a variety of purposes. They are an essential information source for both the public and the government. They keep an eye on government operations and to hold the administration responsible they play as pressure groups. They participate in advocacy and propose substitute regulations for the executive branch, the business community, and other organisations. They provide services, particularly to the underprivileged and the destitute. They fight to protect and alter societal norms and practices while defending citizens' rights (Ingram, 2020).

The perception of CSOs and community people towards the river pollution in and around Dhaka is essential for an anti-pollution advocacy effort. WKB consortium organized a number of activities to get the perceptions of the civil society leaders through river talkies and dialogues. To gather perceptions of the community people there were community consultation meetings and events in the riverbank schools. To engage and aware mass people along with creating a common platform for the policy makers, civil society and community leaders the consortium organized river festivals and river carnival. All the recommendations of the civil society leaders, academics, policymakers, students, community leaders and activists participated in these events and activities are incorporated in the recommendation chapter of this SoDE report.

4.1 River Talkies

The River Talkies are an innovative approach to gather CSO leaders' opinion through Open Stage talk show held at the riverbanks. WKB Consortium organised 9 'River Talkies'. The River Talkies covered various aspects of river pollution and the significance of rivers in the culture and livelihood. Prominent personalities and community people attended the River Talkies and shared their perceptions of the river and other pollution. The discussions pointed out the river's significance from the beginning of Bangladesh. Furthermore, they also identified various aspects of the river in relation to women and youth, health, laws, urbanisation and even art and culture. Most of the discussions revolved around the dire straight of the Rivers around Dhaka and how they can be saved. The following issues were discussed in the River Talkies by the respective speakers and the community representative who were concerned about river pollution.

1) Urbanization of Dhaka along the riverbanks
2) Influence of rivers on Culture, Art, and Artists
3) Youth and River
4) Water Pollution and Problems of Women
5) The role of rivers in the liberation war of Bangladesh
6) Laws to protect Rivers
7) Health Impacts of River Pollution
8) River-centric life and livelihoods
9) Rivers for communication

In the 9 River talkies, following civil society leaders took part to the discussions: Dr Adil Mohammad Khan, General Secretary, Bangladesh Institute of Planners, Manik Hossain, President, Bosila Old Primary School, Gedu Mia, Member, Buriganga Boatman Association, Saraf Anjum Dhisha, Senior Research Analyst, Innovations for Poverty Action Bangladesh, Hasan Masood, Bangladeshi Actor & Social Activist, Nazmun Nahar Keya, Visual Artist & Lecturer, Jagannath University, Abir Abdullah, Documentary Photographer & Photo editor, Daily Prothom Alo, Moktadir Ibne Salam, Filmmaker, Ahmed Reza, Diplomatic correspondent, Jamuna Television, Raoman Smita, Founder President, Global Law Thinkers Society, Abdullah Sani, Advocate, Dhaka Judge Court, Prof. Dr. Ahmad Kamruzzaman Majumder, Professor, Stamford University Bangladesh, Dr. Sharmind Nilormi, Associate Professor, Dept. of Economics, Jahangirnagar University, Sadia Chowdhury, Journalist, Deepto Television, Tanzila Ahmed, BAPA Youth, Asma Khatun, Former UP Member, Faisal Ahmed, Editor & Researcher, River Bangla, Mr. Kamrul Ahsan Khan, Freedom Fighter, Jannati Akhter Ruma, Former UP Member, Mohammad Azaz, Chairman, River Delta Research Centre, Mr. Mohammad Golam Sarwar, Assistant Professor Dept. of law, University of Dhaka, Ms. Dr. Syeda Nasrin, Advocate, Supreme Court of Bangladesh, Shahinoor Akhter, Service Promoter, Satellite Clinic, Nari Moitri, Proff. Hasnat M Alamgir, Chairman, Dept. of Public Health, AIUB, Mandira Guha Neogi, Project Manager, Policy & Food System, Global Alliance for improved Nutrition, Dr. Abu Mohammad Zakir Hussain, Former Regional Advisor, Environmental Health & Climate Change, South-East Asian Regional Office of WHO, MD Monir Hossain, Chairman, Bangladesh River Foundation, Nitta Babu Rajbongshi, Member of Aminbajar Fisherman Association, Amzad Ali Lal, General Secretary, Aminbazar Ghat Shramik Union, Shuman Shams, Founding President, Nongor Bangladesh, Ibnul Syed Rana, Chairman, Nirapad Development Foundation, Nikhil Chandra Bhadra, Coordinator, Sundarban & the Coast Protection Movement and Md Suruj Mia, Convenor, Barogram Balu River Coalition. The main features of the discussions in the River Talkies are furnished below.

The development plan neglects rivers and water bodies, government officials, and influential local figures often involved in the encroachment. There is no authority holding them accountable under the law. The relocation of tannery industries has not only damaged our city but also harmed the local community's livelihood and the environment. The previous generations have caused river pollution in the name of development, leaving the new generation to bear the consequences.

Some iconic works of art have ingeniously and vividly depicted rivers in Bangladesh. Music has always had a significant impact on people's lives. The musicians are also greatly influenced by the rivers. River is inextricably involved with the paintings of the artists of Bangladesh. Photography and filmmaking in Bangladesh are also greatly influenced by the rivers. Artists also feel the necessity to save the river, and they are doing various activities in anti-pollution movements.

The youth can play the pivotal role in any significant changes. They can move forward to save the river from pollution and grabbing of river areas. If we can increase the consciousness of the young generations towards the river and nature, it will work for saving our rivers importantly. The youth should be actively involved in policy formulation and implementation.

the young generations towards the river and nature, it will work for saving our rivers importantly. The youth should be actively involved in policy formulation and implementation.

Lack of access to clean water is identified as a significant problem for women. It increases women's responsibility because they take care of household works more, including water fetching, boiling water, and purring in the filter. Polluted water used for various household tasks exposes children and women to waterborne health hazards. The poorer communities living along the riverbanks are especially vulnerable, as malfunctioning ETPs contaminate both river water and surrounding soils.

During the war of independence of Bangladesh, the rivers played a crucial role for our freedom fighters. They were well-acquainted with the rivers and waterways, unlike the Pakistani fighters, who found the environment completely unfamiliar. The Pakistani forces were fearful of the rivers and struggled to advance in naval warfare.

Although there is the act (Bangladesh Environment Conservation Act 1995), control of environmental pollution is unlikely where there are factories. A full copy of the High Court's ruling declaring the rivers a 'living entity in 2019 has become a landmark judgment for us and a model for the world. A commission was set up to protect the country's rivers in 2013. However, this commission only has the power to make recommendations but cannot play an influential role. There is a lack of accountability of law enforcement authorities. Community people showed concern about laws and regulations and presence of the antibiotic and birth control pills in the river water, which is very harmful to the riverine community. Strengthening the National River Conservation Commission and including local people in law formation can make a better position for implementing the laws.

Chemicals and pesticides used in agriculture mix with river water and pollute the river. Drinking this polluted water causes damage to human health, from the human brain to the reproductive system. The kidney and liver are the most affected part of the body. Children have asthma, heart disease, physical disabilities and other waterborne diseases. It is necessary to inform the people that polythene, plastic bottles, and packets of chips cannot be thrown in the river.

Nowadays people do not see large boats in the rivers due to a lack of navigability. Most of the river’s width has been reduced as well as lost its natural flow due to encroachment and pollution. The country's waterways are disappearing because of land grabs. Due to pollution, people have lost interest in using the waterways, although river communication is much more economical. Our development plans formulated and implemented without thinking about the river’s health. As there is no fish in the river, the fishing community has disappeared.

It is necessary to take the opinion of the riverside people to implement the development plan adopted to protect the river because they are victims and can give proper advice to protect the river. Fishing community is unemployed for eight months a year because there is not enough fish in the river. VGF (Vulnerable Group Feeding) cards are given to coastal fishermen, however, there is no initiative to provide incentives to those who live on the banks of small rivers like Turag or protect their livelihoods. River-centric livelihoods are going to be extinct due to river pollution or coping with alternative livelihoods. It is a concern for the next generation of the riverbank community.

Photographs:

Figure 61: River Talkie 1 - Urbanization of Dhaka along

Figure 62: River Talkie 2 - Influence of rivers on Culture, Art and Artist

Figure 63: River Talkie 3 - Youth and River

Figure 64: River Talkie 4 - Water pollution and the problems of women

Figure 65: River Talkie 5 - The role of rivers in the liberation war of Bangladesh

Figure 66: River Talkie 6 - Laws to protect Rivers

Figure 67: River Talkie 7 - Health impact of river pollutions

Figure 68: River Talkie 8 - River-centric life and livelihoods

Figure 69: River Talkie 9 - Rivers for communication

4.2 Dialogues

WKB organized 2 dialogues with civil societies. The dialogue expected the following outcomes:

1. Create the scope for further dialogue between government authorities, tannery owners and civil society organizations to bring forward the long pending issue.
2. Strengthen local community and CSO/CBO's movement on curbing river pollution.
3. Engage people and mass media in favor of anti-pollution movement.

Here is a glimpse of the discussions took place in those dialogues.

The first Dialogue was organized with CSOs and Relevant Government Authorities as part of the advocacy process. The topic for the first dialogue was "River Pollution by Tannery Industries". The dialogue was attended by CSOs, government officials, tannery owners, CBOs, journalists, schoolteachers, and community leaders. Among other Dr. Md. Nurul Islam, Professor, Department of Geography and Environment, Jahangirnagar University, Eliasur Rahman Babul, Dhaka South City Corporation Ward Councillor and Senior Vice-president of Bangladesh Tanners Association; ABM Masud, leader, Bangladesh Tanners Association; Monir Hossain Chowdhury, Environment and Climate Change Specialist, National River Conservation

Commission; Ms. Fatema-tuz-Zohra, Inspector, Department of Environment; Rumana Afroze Dipti from BELA; Mohammad Azaz, Chairman, River and Delta Research Centre attended. Besides, representatives of NGOs, CSOs, CBOs and journalists attended.

Speakers of the dialogue urged that the government need to prepare a roadmap to stop pollution in the vicinity of the tannery industries at Hemayetpur, Savar. Relocation of the tannery industries from Hazaribagh to Savar did not produce any good results. In fact, it has contaminated another river. The new site at Hemayetpur does not have enough space. It is spread over 200 acres, but there is a need of more 400 acres to properly manage waste. The people do not want to lose the river in the name of development. Department of Environment is not issuing approval for any new tanneries. The dialogue was covered by print media.

The 2nd dialogue was held on 20 April 2022 with the title "Empowering NRCC to comply with court order to protect river pollution". The dialogue was attended among others by Dr. Mujibur Rahman Howlader, Former Chairman, National River Conservation Commission (NRCC), Mr. Mainuddin Ahmed, Chief of Party, Promoting Advocacy and Rights (PAR), Counterpart International, Mohammad Golam Sarwar, Assistant Professor of Law, University of Dhaka, MS Siddiqui, Advisor of Bangladesh Competition Commission, Mohammad Azaz, Chairman, River and Delta Research Centre; Md. Alamgir Hossain, Head of Laboratory, Dhaka WASA attended. Besides, representatives from NRCC, union parishad members, CSO and CBO representatives attended.

Participants of this dialogue emphasized on the formation of effective river commission for the protection of rivers in the country and called for enacting of NRCC law following court's directives as well as its proper implementation to protect rivers. NRCC was formed in 2013 according to 2009 High Court's order. However, an act had been drafted in 2020 which has not been enacted. The court has given much importance to the lack of coordination to protect the rivers. The government departments involved in river protection need to be sincere. The implementation of any legal framework depends on the respective implementing agency, and the performance of any organization depends on its leadership. Therefore, to save rivers of Bangladesh, an effective and independent river commission with competent leadership is very crucial at this stage. Though parliament has been passing many bills, they did not bother to discuss about rivers of Bangladesh any day in the parliament. The participants blamed the government for not enacting the draft 2020 NRCC act and agreed that NRCC should be equipped with proper legal instruments and human resources as soon as possible for saving the rivers.

Photographs:

Figure 70: Dialogue 1 : River Pollution by Tannery Industries

Figure 71: Dialogue 2: Empowering NRCC to comply with court orders to protect River Pollution

4.3 Community Meetings

WKB Consortium organized nine Community meetings. The first three community meetings were organized to form river coalitions i.e., Buriganga River Coalition, Turag River Coalition and Balu River Coalition. The community meetings were participated by river coalition members, community people, community leaders and representatives of community-based organisations. The subsequent meetings were organised with the support of three River Coalitions. These events were organized in different places of Dhaka city. The areas were covered by these events were Bosila, Kamrangirchar, Nawabganj Park (Lalbagh), Kayatpara Bazar (Balurpar, Khilgaon), City Daffodil School (Trimohoni, Khilgaon), Uttara Govt Primary School (Moricharteck, Aminbazar), Trimohini Bazar (Trimohoni, Khilgaon), Aminbazar Landing Station Ghat (Aminbazar). The main objectives of the community meetings were:

1. To increase the awareness of the community members on the water, air and noise pollution in Dhaka city.
2. To organize community members to advocate to reduce water, air and noise pollution in Dhaka city.
3. To formulate a coalition of the CBOs on the bank of river Buriganga through a consultation with the CBO leaders.
4. To discuss the present situation of river pollution and what can be done to protect rivers.

Through these meetings, communities of Dhaka city came up with many important aspects of river pollution and its mitigation approach. Here's a glimpse of what was discussed at those community meetings.

The river water is now unusable due to unplanned development and pollution. The people are aware of the ongoing trend of power politics and rivers are the victim of land grabbers and polluters who are politically powerful. If the water of Buriganga can be purified properly and made usable again, it can be distributed by WASA, which will significantly reduce the cost of collecting groundwater and carrying water from distant rivers (i.e., Padma). However, some discussants said that even if it is purified, the water of the Buriganga is not fit to drink. Chromium emitted from tanneries is contaminated with water which is causing other diseases including cancer. The government should have come forward more strictly regarding rules and regulations. The land must be measured according to the CSA records of the British period and all canals to be freed from illegal occupation and the boundary pillars of the river to be resettled.

The humanitarian catastrophe caused by river pollution has spread all over Dhaka. Factory and household wastes are discharged into the river and polluting the river water. The people on the banks of the river Karnatali are plagued by upstream tannery and textile pollution and immediate, transparent, and concerted action to be taken to stop pollution. Children's immunity system is declining; they are facing hormonal problems, the physical structure is being disrupted, and they are experiencing other health problems. Apart from health problems, river pollution also impacts lives and livelihoods of community people. About 75% of workers have no job in the Aminbazar area (adjacent to the Turag River) due to river pollution. Rivers and workers' well-being are correlated. If workers cannot drink clean water, they will lose physical strength. Rivers are polluted by waste and various development interventions. If people create pressure on the river in this way, the river will die out. Besides, a pollution-free river is the right of the dock labourers. The participants marked river pollution as a social problem and are motivated and strongly want to reduce the pollution and save the rivers collectively. If the awareness of the local community (especially at the ward level) and proper implementation of law and order becomes effective, the river can be restored.

Photographs:

Figure 72: Community meeting 1- To Formulate a coalition of the CBO's/ NGOs in the bank of river Buriganga

Figure 73: Community meeting 2: Buriganga River

Figure 74: Community meeting 3: Buriganga River pollution and its remediation

Figure 75: Community meeting 4: Balu River pollution and its remediation

Figure 76: Community meeting 5: Balu River pollution and its remediation

Figure 77: Community meeting 6: Turag River pollution and its remediation

Figure 78: Community meeting 7: Balu River pollution and its remediation

Figure 79: Community meeting 8: Balu River pollution and its remediation

Figure 80: Community meeting 9: Turag River pollution and its remediation

4.4 School Workshops

WKB organized school workshops with the objective to educate students on the environment, environmental pollution, causes of pollution with a particular focus on water, air and noise pollution of Dhaka city. The workshops were attended by teachers, the school management committee members, parents and representatives of Buriganga River Coalition. The first school workshop was organized on 25 October 2021 at Basila High School by the riverside of Buriganga and the second school workshop on 11 November 2021 at Sheikh Jamal Government High School, Kamrangirchar by the riverside of Buriganga. The followings were targeted as the immediate outcomes of the workshops.

1. Increased level of awareness of the students on the pollution issues.
2. Students and teachers identified the major challenges and way forward.
3. Students developed their group action plan to fight environmental pollution.
4. Students' and teachers' commitments towards the protection of the environment increased through oath-taking.

The school workshops were organized in two segments. The first part was an opinion exchange meeting. The second part was the workshop with students and teachers where participants discussed the environmental situation, causes of environmental pollution and what to do. Students participated in the school workshop filled up a pre-event questionnaire before starting the workshop and a post event questionnaire after the workshop. Teachers and students attended an oath-taking session to prevent river, air and noise pollution. Hygiene and educational materials were distributed among participant students in the workshop. Students identified the causes of pollution and way forward in the session through group work and developed action plan to work on environmental issues.

The participants of the workshops emphasized mass awareness of the river pollution issues to save Buriganga. The river is life and if people want to live, they must keep Buriganga river clean.

People in other countries are more concern about their rivers than us. The amount of dissolved Oxygen in polluted water decreased to zero and that leads to the scarcity of fish. To save the rivers, guardians must make their children aware of this issue. River is a living entity and if it dies, the people will not get water. We all must take actions to save the rivers. The river should be protected in a way that it becomes the centre of recreation.

Photographs:

Figure 81: School Workshop 1

Figure 82: School Workshop 2

4.5 River Festivals

WKB Organized 2 river festivals with the main objective to build awareness and protect the river from pollutions. The other objectives were to engage local community members, CSOs/CBOs, NGOs, youth, media, academician, artist and public figures in protecting rivers and to bring river pollution into the mainstream policy discussion and enhance environmental justice and political consequence of river pollution. The first was Buriganga River Festival and the second was Balu River Festival. The Buriganga River Festival was held on 26 and 27 November 2021 and the Balu River Festival was held on 25 and 26 November 2022. There were promotional activities like bicycle rally, canoe boat race, art competition and mime show etc. There were stalls for demonstration of activities by different organizations.

The river festivals were attended by renowned personalities from different sectors of societies and officials from different government departments. Among others Md. Atiqul Islam, Mayor, Dhaka North City Corporation, former advisor to the caretaker government advocate Sultana Kamal, Taqsem A Khan, Managing Director and CEO of Dhaka WASA, Syeda Rizwana Hasan, CEO of BELA, Khushi Kabir, Social Activist and Coordinator, Nijera Kori, Badiul Alam Majumdar, Founder Secretary, Shushashoner Jonno Nagorik (SHUJAN), A. K. M. Shahid Uddin, Deputy Managing Director (O&M), Dhaka Water Supply and Sewerage Authority (Dhaka WASA), Professor Dr. Ahmed Kamruzzaman Majumder of Stamford University Bangladesh attended. Besides, political leaders, representatives of USAID and Counterpart International, representatives from fisherfolk communities and boatmen communities, community leaders, and local school headteachers and CSO representatives attended. The participants attended the river festivals opined the following issues.

We must bring the river as our front and save the rivers. Saving the rivers means saving ourselves. Citizens of Dhaka to come forward to protect the Buriganga river, the lifeblood of Dhaka from pollution. In the past citizens used to ride bicycles on the banks of Buriganga river, but now they cannot. Artists are also interested in protecting the rivers. Programs like river festivals make people aware to keep rivers free from pollution. Youths can play important roles to save the rivers. The developer companies while sale plots, they show design of the housing estate where they promise market, playground, and many other facilities. But they forget everything after sale of the housing lands. Environmental movement to think about legal initiative so that the developers fulfil their commitments. The canal rescue and clean-up activities are being carried out with the help of the people under the initiative of DNCC. Masterplans for the rivers should not be project based. These should be solution oriented. It took 55 years to save the Thames River of London. If we try, we shall be able to save our Buriganga. Local people living by the river should be included in any river-related planning. Members of Parliament are involved in river grabbing. Saving rivers will bring benefits to tackle climate change impacts. Fishermen can fish only two months in the Buriganga river, rest of the months they do not have earnings. As most of the fishermen are not educated, they cannot change their occupation. Dhaka is surrounded by four rivers, however, due to encroachment and pollution all these rivers are being destroyed. The rivers have become the back of the settlement. Rivers flow normally. There is no benefit in obstructing its flow by encroaching and polluting the rivers for the interest of individuals or groups, rather it harms the environment. Policies should be formulated for the benefit of the people by protecting the environment. It is the responsibility of people's representatives to work collectively to prevent river pollution and encroachment. Regardless of party affiliation, everyone should work together to stop river pollution and encroachment. It is said that any project undertaken by the government should be implemented by not harming the river, canal, haor and the environment. Pollution-free environment, rivers and air can be ensured through people's participation and social movement. Dhaka WASA prepared a plan to manage the sewerage of Dhaka city under its network. It is hoped that the issue of river pollution by sewerage will be resolved through sewerage treatment plants. Due to the waste of Dhaka city, Balu, Debdolai, and Norai rivers have been destroyed. Movement will be needed to prevent river pollution and build pollution-free rivers and protect river resources.

Photographs:

Figure 83: Inauguration (Buriganga River Festival)

Figure 84: Inauguration (Buriganga River Festival)

Figure 85: Mime show (Buriganga River Festival)

Figure 86: Dingi Boat Race (Buriganga River Festival)

Figure 87: Cycle Rally (Buriganga River Festival)

Figure 88: Children Drawing Competition (Buriganga River Festival)

Figure 89: Speech of the Festival- Buriganga A Living Entity (Buriganga River Festival)

Figure 90: Tales of Buriganga (Buriganga River Festival)

Figure 91: Chief Guest Visiting the Stall (Buriganga River Festival)

Figure 92: Different Stalls (Buriganga River Festival)

Figure 93: Cultural Program (Buriganga River Festival)

Figure 94: Closing and Prize Distribution (Buriganga River Festival)

Figure 95: Inauguration (Balu River festival)

Figure 96: Inauguration (Balu River Festival)

Figure 97: Lathi khela (Balu River Festival)

Figure 98: Balish (pillow) game for women: (Balu River Festival)

Figure 99: Football match (Balu River festival)

Figure 100: Boat race (Balu River Festival)

Figure 101: Prize Distribution (Balu River Festival)

Figure 102: Winner of the boat race (Balu River Festival)

Figure 103: Cultural Program (Balu River Festival)

4.6 River Carnival

The river carnival was another event that helped mobilize the ideas of civil society. Buriganga River Carnival was organized on Saturday 10 September 2022 in pursuit of pollution free river with the slogan "Pollution-free Buriganga is the demand of Dhaka residents" at Kamrangirchar of Dhaka. Government officials, political leaders, local elected bodies, community people, CBOs attended the event. The event was organized in two segments, i.e., the inaugural session including procession and discussion and colourful boat rally. The immediate outcomes of the event are:

1. Successfully engaged community people, CBOs, youth, media, academician, government, local elected bodies, to demand pollution free river;
2. Commitment, engagement and solidarity against river pollution from the local elected bodies (Ward Councillors and the Member of Parliament), government departments (BIWTA, NRCC).
3. Engaged mass media in favor of the anti-pollution movement.

Former adviser to the caretaker government and eminent human rights activist Sultana Kamal, Advocate Qamrul Islam, Honourable Member of Parliament of Dhaka-2 constituency, ward Councillors of Dhaka South City Corporation, representatives of USAID and other international NGOs, political party leaders, representatives of BIWTA, environmental experts, representatives of NRCC, law enforcement agency representatives, university teachers and CSO and CBO representatives attended the event. The main features discussed at the event are as follows.

Dhaka is surrounded by four rivers and these rivers are connected to the numerous canals. These rivers are getting polluted in various ways. All over the world, the river is the front side of human settlement, it should be the same in Dhaka. However, over time, due to a lack of proper garbage management, rivers became backyard or waste dumping grounds. If we cannot save our rivers, we cannot protect our riverine country. People behind the illegal grabbing of rivers across the country belong to the government party. We want to see the river get back to its previous glory that was seen 60 years back. The current government has plan to start waterbuses in Dhaka city, if the river pollution stops, it will be possible to start these boats and traffic congestion in Dhaka will be largely reduced. There are activities by vested interest groups that polluting the river. We must commit to protecting Buriganga and other rivers. People must work together with government, social workers, civil society, riverbank community to save rivers. Analysis of the legal framework and application of laws and regulations related to the river and its pollution helps the government to take initiative or policy formation to protect river and other pollution. We all have responsibility to protect rivers. People must make promise not to throw garbage into the river and not run boats that pollute river water.

Photographs:

Figure 104: Opening Session
(Buriganga River Carnival)

Figure 105: Opening Session
(Buriganga River Carnival)

Figure 106: Rally of the Buriganga River Carnival

Figure 107: Boat Rally (Buriganga River Carnival)

Figure 108: Boat Rally (Buriganga River Carnival)

Figure 109: Boat Rally (Buriganga River Carnival)

CHAPTER FIVE: POLICY AND LEGAL FRAMEWORK

Constitutional provisions, parliamentary acts, rules, policies, and guidelines make up the legal framework governing air, noise, and water pollution. The Environment Conservation Act 1995 (as amended in 2000, 2002, and 2010), the ECR 1997 (as amended in 2002, 2005, and 2010), the National Policy for Safe Water Supply & Sanitation 1998, the National Water Policy 1999, the Bangladesh Environment Court Act 2000, the National Policy for Arsenic Mitigation 2004, the Environment Court Act 2010, the Climate Change Trust Act 2010, and the Environment Pollution Control Ordinance of 1977 are among them. The ECA of 1995 required the establishment of the DoE, which is now managed by a Director General. This department handles all actions that are linked to environmental contamination. To promote a healthy environment, clean water, and balanced development for the benefit of the country, the CEGIS was established. The relevant ministries of the GOB are in charge of protecting and directing the development of all environmental pollution-related choices, together with the ministries of water resources, environment, forest, and climate change. In cities, surface water contamination is regulated by the Water Supply and Sewerage Authority (WASA). To oversee water supply and management, they operate offices in big cities (Uddin and Jeong, 2021).

5.1 Legal Aspects of Buriganga River Pollution

Besides the Bangladesh Water Act of 2013, there exist other forms of evidence and regulations that govern water pollution in Bangladesh. The article 18A of the constitution of the People's Republic of Bangladesh states that, "The state shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetland, forests and wildlife for the present and future citizens". In 1992, Bangladesh initiated the Water Resource Planning Act with the aim of developing water resources and ensuring equitable utilization. Under this act, the Water Resource Planning Organization was established with the responsibility of formulating national policies to scientifically manage and preserve water resources in Bangladesh. The Territorial Waters and Maritime Zones Act, 1974 includes provisions regarding the preservation of marine ecological balance and quality. Before the enactment of the Environmental Conservation Act (ECA) of 1995, the Agricultural Pest Ordinance of 1962 did address pollution issues, but there was no subsequent coordination between the two acts. The ECA specifically focuses on mitigating and controlling environmental pollution in Bangladesh. Under Section 4(3), the Directorate General (DG) may guide the closure, prohibition or regulation of any industry. The Environmental Conservation Rules (ECR) of 1997 provide explicit guidelines for the identification of different legal entities as pollution under control certificates. However, in 2023, a new Environmental Conservation Rules has been enacted with an aim to reduce environmental pollution. This rule has urged to classify industrial projects and units based on their activities, pollution, and potential harm to the environment and health. The Bangladesh ECR of 2023 introduce stricter classifications for industrial projects based on their environmental impact, with detailed categories and requirements for location and environmental clearance certificates. These rules enforce a rigorous timeline for processing applications, including public hearings and specified extensions. Additionally, they outline a structured appeals process for dissatisfied parties, ensuring transparency and accountability in environmental regulation. These certificates are crucial for ensuring compliance with environmental regulations and managing pollution effectively. Additionally, the ECR establishes standards for Environmental Quality Standards (EQS) to govern and maintain the quality of air, water, noise, emissions, and discharges. Under the Ecological Court Act, three courts operating in the country experienced a total of 17 cases filed in 2018 (with a cumulative total of 77 cases filed since 2012) in the Dhaka court. The Supreme Court has played a significant role in addressing water pollution by delivering landmark judgments in Public Interest Litigation (PIL) cases filed by NGOs (Arifuzzaman et al., 2019).

5.2 Analysis of Legislative Landscape

The analysis of laws and policies helps to unveil their strengths and weaknesses which are significant to understand their feasibilities in terms of enforcement. Such analysis not only identifies the challenging factors of enforcing laws and policies but also indicates possible reform measures to increase their enforcement.

The study attempts to review and analyse the laws, rules and policies relating to air, noise and water pollution in the context of Bangladesh. The review of the laws portrays how the legal framework aims to address the issues of air, noise and water pollution while containing both administrative and judicial measures. The close examination of the laws and policies assesses the compatibility of the legal provisions along with the competence of implementing institutions to prevent air, noise and water pollution. In some cases, the legal provisions concerning air, noise and water pollution are found to be vague, inconsistent and incoherent. At present, there is no comprehensive law or rule except a Draft Rules to prevent air pollution. There remains uncertainty as to the adoption of the Rules to prevent air pollution while the country is witnessing worst level of air pollution especially during the winter season. The Bangladesh Environment Conservation Act (BECA) 1995, the Environment Conservation Rules 1997, the Noise Pollution Control Rules 2006 offer administrative and penal measures to prevent noise pollution in the country. BECA along with Bangladesh Water Act 2013 and National River Conservation Commission Act 2013 provide measures to prevent water pollution and protect water resources and rivers of the country. However, all the laws and rules contain some lacunae that impede the proper execution and frustrate the objectives of those and rules. The laws provide ample power to the executive and administrative authorities without containing any accountability provision in cases of irregularities and malpractices in discharging their powers and functions. Such enormous power without responsibility acts as challenge to hold the implementing stakeholders accountable. Along with such lack of accountability, the laws provide immunity to the executive through saving provisions like good faith clause. The good faith clause, being vague and wide, may be used as a shield to justify the malpractices of administrative authorities including the DoE and its officers even, they commit any irregularities. The executive primacy is also reflected in the initiation and disposal of environmental disputes. To take action against air, noise and water pollution, the aggrieved persons are not allowed to file cases directly before the environment courts rather they require taking permission from the executive body like the DoE. Such restrictive approach to vindicate the environmental rights is contradictory with the access to justice of the victims of environmental pollution. It is noted that to attain the objectives of the laws, rules and policies on air, noise and water pollution and ensure their proper enforcement, the loopholes and challenges identified in the present study should be duly considered. The study suggests possible recommendations in the existing laws and rules that will, arguably, enhance the feasibility of those laws and rules to function effectively. To address the legal and policy gaps, the study also identifies some action points to be undertaken by the government and non-government actors.

5.3 Analysis of Court Orders

Pollution is a major problem for Bangladesh as most of the elements of environment including river, air and noise are contaminated. After independence in December 1971, Bangladesh had to go through a lot of political struggle and administrative crisis, until recently the crisis has been subsided by strong political governance. Amidst the political struggles, the agro-based Bangladeshi economy is now embracing industrial, commercial, and infrastructural development at a large scale. Although this development enhances environmental pollution, until the last decade conservation of environment and biodiversity neither came into close consideration of the authority concern nor people at large. Resultantly, human consumption and development remained unrestricted, unplanned and uncontrolled. Rivers, river-bank areas, lakes, canals, water-fields, wetlands, ponds, forests and forest lands, sea areas, hill areas, wildlife and many other places which were supposed to be preserved for maintaining ecological balance and sound environment were unlawfully being encroached and grabbed by illegal occupants. Air and noise pollution also went beyond human tolerance level, whereas law enforcement agencies remained inactive, seldom aiding in the process of illegal grabbing and contamination. On the other hand, existing legal provisions fell short for tackling the issues concerning environment and original Constitution also lacked specific provision for conservation of the environment.

Despite all the shortcomings, Court has opened a new horizon in the legal arena for protecting and conserving the environment in Bangladesh. The Court has successfully attempted to mitigate the existing lacuna, entertaining public interest litigation advanced by the lawyers serving probono to the society or exercising jurisdiction Suo moto under Article 102 of the Constitution of the People's Republic of Bangladesh. Court has recognized that conservation of environment, protection of biodiversity and maintaining ecological balance falls within the fundamental right to life as guaranteed under the Constitution. It has also considered that the Government and the law enforcement organs are under obligation to adopt necessary legislations (primary or secondary), frame policies and implement the Courts' verdicts for conserving the environment, thus securing the right to life. Court has always played significantly positive role in addressing environment related issues. It is worth mentioning that some of the judgments of the Court have compelled the Legislature and the Executives to formulate laws, policies, rules, regulations and other steps. Owing to the Courts' verdicts, Buriganga, Turag, Balu, Shitalakshya, Piain, Dawki and Dhala rivers and few others are being recovered from the possession of the illegal grabbers; forest areas are being preserved; ecologically critical areas are being identified; development works are being brought under regulations to control and reduce noise and air pollution; sea side and coastal areas are being protected from illegal occupants; lakes are being saved; and many other environmental issues are being addressed, protected and resolved. Amongst others, by directing the concerned authorities and other stakeholders from destroying the forest and thereby to take appropriate steps for preserving forest, protecting the canals and water fields, shielding the fisheries, taking steps for preventing air and sound pollution coming from factories and commercial units, deterring the environmental law violators for causing pollution by way of awarding fine or jail, cancelling licenses, directing to remove unauthorized and illegal establishments and in many other environmental issues, the role and contribution of the Court is undeniable and undisputed in Bangladesh.

While the Courts' approach is mostly affirmative towards conservation and preservation of environment - pollution is increasing which is acutely contributing to the environmental damage at an uncontrollable rate; a situation which Courts' optimism is not enough to address. Multiple practical barriers contribute to the inadequacy of the Court's attempts, all of which are human made and arise out of, inter alia, negligence, arbitrariness, greed, lack of understanding, unplanned development strategy, lack of good governance, lack of having the sense of environmental care, and non-implementation of the Courts' verdicts or delaying the implementation process are responsible. Additionally, executives' inertia, lack of combined activism, manipulation and corruption are also responsible. Top of that, the non-compliance culture and inordinate delay are responsible in executing the Court orders. Lack of having adequate and effective legislations and policy is a major concern, and on that note this, participation of the corporations and people at large is highly essential for creating a balance between development and environment.

In any case, human consumption and ecological balance should be maintained in order, and new development related laws should be made, or historical ones should be amended, clearly prioritizing the environmental precaution in short term and long-term basis. Courts' verdicts are also needed to be executed without inordinate delay or latches, where enabling the Environment Courts in each District will accelerate the purpose of the conservation of environment. Saving environment, saving life – should be reflected in all actions, plans and decisions of the Legislature, Executive and Judiciary, which will get more acceleration with the active engagement of civil society.

5.4 Government Initiatives of Reducing Water Pollution

Bangladesh has well-constructed and comprehensive national policies to reduce water pollution that contain adequate clauses to address water quality protection, involvement of civil societies and NGOs, land zoning, and various regulatory systems. The GOB has integrated multiple plans and programs within its five-year plans to effectively control water pollution (Rahman, 2011). Currently, 13 different ministries and 35 governmental organizations are entrusted with water resource management (figure 100). These organizations are responsible for taking various steps to reduce and control water pollution in the country and are bounded by some laws and policies. For example, the Department of Textiles of the Bangladesh Government approves Effluent /Environmental Treatment Plant (ETP) setups for textile facilities but does not do regular Environmental Impact Assessment (EIA). The latest and most significant water policy in Bangladesh is the Water Act of 2013, formulated by the government. This act amalgamates provisions from previous regulations and policies related to water management. However, it does not adequately address certain aspects, such as water pollution.

It does not incorporate specific regulations regarding the use of fertilizers and pesticides too. The National Water Policy of 1999 also lacks sufficient acknowledgment of these issues. Furthermore, the National Industrial Policy (NIP) of 2010 does not provide guidelines for safeguarding the environment from industrial pollution. Additionally, the Disaster Management Act of 2012 does not make explicit mention of water pollution as well (Petrie and Hoque, 2014).

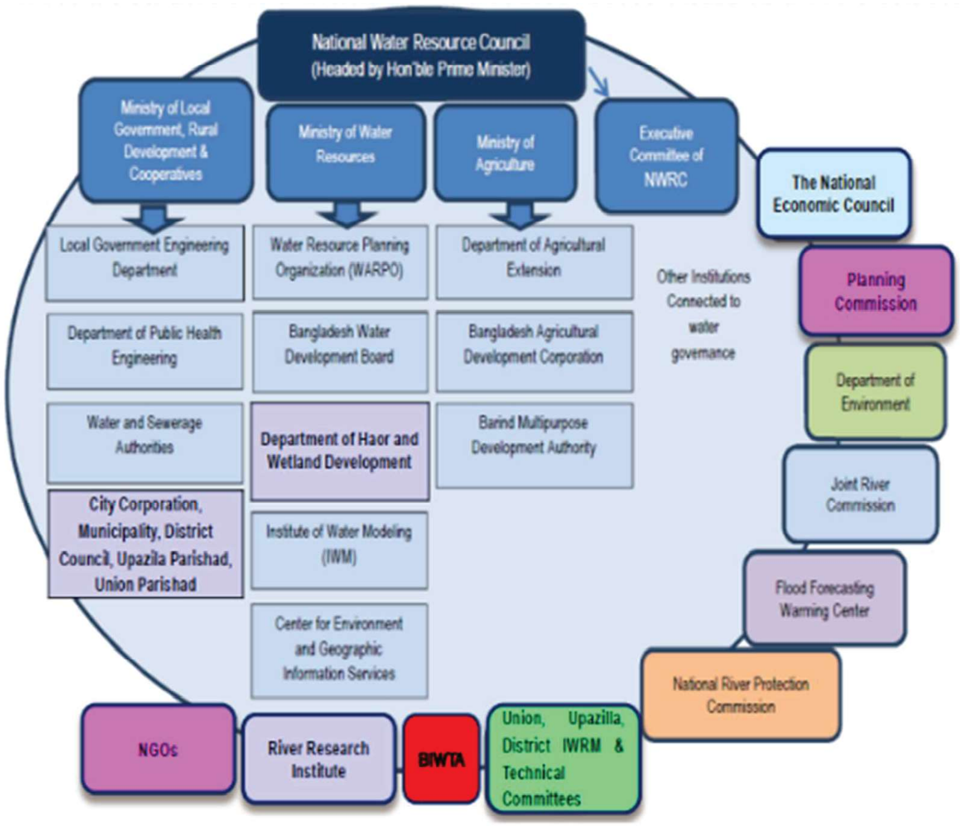


Figure 110: Water governance responsible institutions in Bangladesh (Arifuzzaman et al. 2019)

The discussion that follows will make an effort to analyse the parts of these legal documents that allude to taking action to avoid water, noise, and air pollution.

5.5 Major Policies and Laws

In the following section, a brief discussion of the major policies and laws is illustrated below.

5.5.1 Water Resource Planning Act, 1992

This law was passed to protect and better the water resource. The Act's Section 3 mentions creating the Water Resources Planning Organization as an authority. The organization's operations are outlined in Section 7, which also outlines national plans and policies linked to the scientific use and conservation of water resources as well as the implementation of an ecologically sound master plan to ensure the improvement of water resources (WARPO, 1992).

5.5.2 Bangladesh Environment Conservation Act, 1995

The most important environmental law that completely strives to encourage conservation, enhancement of environmental quality, regulation and mitigation of environmental pollution is the Bangladesh Environment Conservation Act 1995. This Act defines "pollution" as any contamination, alteration of the physical, chemical, or biological properties of any air, water, or soil, including change in temperature, taste, odour, consistency, or any other characteristics of air, water, or soil, or discharge of any liquid, gaseous, solid, radioactive, or other substance into air, water, soil, or any other environmental constituents in such a way as to make such air, water, or soil harmful, injurious, or detrimental. The concept considers many different aspects of environmental pollution, including air and water pollution.

The Act enables the DoE's Director General to take preventative and preventive actions against environmental contamination. The Act offers both administrative and legal remedies for those who harm the environment, including those who pollute the air and water. The Act requires the Director General (DG) to implement programmes for monitoring the quality of drinking water, compiling reports on such observations, and providing advice or, if necessary, issuing directives to the relevant parties to respect drinking water standards. The DG has the authority to take action to grant relief to anybody harmed or expected to be harmed because of pollution or environmental degradation. The DG may also order the offender who caused harm to the environment to make restitution and conduct corrective action. Even the DG has the right to bring a lawsuit for damages in the appropriate court or institute legal action against someone for disobeying the order. The issue of noise pollution is not directly addressed in the Environment Conservation Act of 1995. However, "improvement of the environmental standards, and control and mitigation of environmental contamination" are the Act's main goals. As a type of environmental pollution, noise pollution falls beyond the purview of the Act. The promulgation of the Noise Pollution Control Rules, 2006 under this Act lends additional credence to this. The BECA enables the DoE's Director General to conduct preventative and protective actions against environmental contamination, particularly water pollution. The Act offers both administrative and legal remedies for those who harm the environment, including water contamination. The Act requires the Director General to implement programmes to monitor the quality of drinking water, provide reports on those observations, and offer advice or, if necessary, issue directives to the parties in question to observe standards for drinking water (Sharif and Hannan, 1999).

5.5.3 Water Supply and Sewerage Authority Act, 1996

This Act was passed to govern the sewage system and water supply region. Its goal is to create, advance, and maintain a water supply and sewage system that is environmentally sound. This is important because if there isn't a good water supply and sewage system, water might get contaminated, and contaminated waters could be harmful to people's health, the environment, and daily life. To fulfil the aims, the Act created water supply agencies and specified their roles (WASA, 1996).

5.5.4 Environment Conservation Rules, 2023

To reduce environmental pollution, the Ministry of Environment and Forests of the Bangladesh government has issued the ECR 2023 (SRO No. 53/Law/2023, Dated 5 March 2023).This rule also repealed the prior ones that were enacted in 1997, with immediate effect. Like the previous rules, industrial units and projects are classified into four categories—green, yellow, orange, and red—based on their activities and level of environmental pollution.

The green category denotes a lower impact on the environment; yellow denotes a medium impact on the environment; orange denotes those that have a harmful effect on the environment and human health, and the effect must be reduced to maintain a healthy environment; and red denotes those in industries that have a severe impact on the environment and human health, which must be reduced to maintain a healthy environment. Changes of note are specified below,.

- To establish a new industrial unit or project that is categorized as yellow, orange, or red, the owner must obtain both a location clearance certificate and an environmental clearance certificate from the DoE. For green-categorized industrial units and projects, owners only need to obtain an environmental clearance certificate.
- An exception applies for industrial units and projects set up in government and private export processing zones, economic zones, and industrial cities of Bangladesh Small and Cottage Industries Corporation—regardless of how they are categorized, only an environmental clearance certificate is required; they do not need to obtain a location clearance certificate.
- No one is allowed to establish infrastructure without having a location clearance certificate from the DoE.
- Gas, electricity, water, and other essential services cannot be provided to new industrial units or projects categorized as yellow, orange, or red unless they have obtained a location clearance certificate.
- If there is no Department of Environment office where the industrial unit or project is located, then location clearance certificates and environmental clearance certificates must be obtained from the district office or metropolitan office, as applicable.

5.5.5 Noise Pollution Control Rule, 2006

The ECA of 1995's authority to issue regulations allowed for the adoption of the Noise Pollution Control Rule, 2006.The significance of this instrument comes from the fact that it is the only one in the nation that specifically addresses noise pollution. It tries to reduce noise pollution by giving information on the precise noise levels in various locations as well as certain exceptions to the general rule. According to the rule, the authority has the right to enter any location and seize any equipment that contributes to noise pollution. The rule also outlines a variety of noise pollution-related crimes that are punished. Here are a few of the rule's key components (GOB, 2006).

5.5.6 Bangladesh Water Act, 2013

The integrated development, management, extraction, distribution, use, preservation, and conservation of water resources are governed by the Bangladesh Water Act (BWA), 2013, which was passed. According to the Act, "water pollution" refers to adverse direct or indirect alterations to the organic, chemical, or physical characteristics of water. The ECA of 1995 is to be used to reduce water contamination, according to the Act. All rights to water, including surface water, ground water, sea water, rainwater, and atmospheric water, are granted to the State under this Act on behalf of the people. This clause falls short of granting the people water rights. Instead, the state's decision still determines who has the right to water. It should be noted that the right to water is not mentioned specifically in the Bangladeshi Constitution (GOB, 2013a).

5.5.7 Water Rules, 2018

The Water Act 2013's provisions have been further enhanced by the Water Rules of 2018. In Rule 3, the right to water is discussed. However, the government is responsible for upholding this right, and no one else may take any action to do so. Therefore, it may be claimed that the mention of the right to water as a right lacks the essential elements of a right and is only symbolic. The conditions and steps for getting a project clearance certificate were defined in Rule 13. The requirements for designating any region as a water critical area and its management are outlined in Rules 26 and 27. Rule 41 mandates that the Water Resources Planning Organization gather information on water contamination and submit a report to the EC based on that information (GoB, 2013b).

5.5.8 The Playgrounds, Open Spaces, Parks, and Natural Wetlands Conservation Act-2000

The Act aims to ensure the conservation of playgrounds, open spaces, parks, and natural wetlands located in metropolitan cities, divisional headquarters, and municipal towns of the country. The Act guarantees the protection of playgrounds, open spaces, parks, and natural wetlands by prohibiting any types of activities which is detrimental to them while maintaining the ecological balance with the fast-growing population in the concerned areas. The law provides restrictions regarding the changing of classes of open spaces and wetlands as stipulated in the master plan of the government and imposes penalties for the violation of this obligation (Section 05).

However, the Act lacks specification on some critical points.. For example, the Act does not have any provision that prohibits the construction of any kind of permanent or temporary structure within a determined distance of the water bodies. The Act also fails to insert any provision for restoring the water bodies in case of encroachment which have been marked in survey records and exist in other approved government documents. The Act also creates restrictions on filing complaints except without previous permission of concerned administrative authorities which may jeopardize the interests of the victims and allow the continuation of encroachment of wetlands.

For the purposes of this Act, a natural wetland has been defined as a place declared as flood-flowing land as a river, canal, beel, pond, stream, or fountain indicated in the master plan by the government, and flowing water and the land which conserves the rainwater.

5.5.9 The National River Conservation Commission Act, 2013

The National River Conservation Commission will be established under the Act to prevent illegal encroachment on rivers, water and environmental pollution, river pollution brought on by industries, illegal construction of structures, and other irregularities. The Commission will also ensure that rivers are used in a variety of ways for socioeconomic development, including restoring their natural flow and maintaining them so that they are navigable. The Act's actual text, however, does not mention the goal. It is highlighted that because the Commission is simply an advisory organisation, it is powerless to stop unfair river management practises. It is also true that the law lacks the necessary tools to carry out even its own commitments that go against the goals of the legislative process (GoB, 2013c).

5.5.10 Brick Manufacturing and Brick Kilns Establishment Act, 2013

In the purpose of preserving and enhancing the environment and biodiversity, the 2013 Brick Manufacturing and Brick Kilns Installation (Control) Act aims to regulate brick kiln establishment. The Act requires brick kilns to produce a minimum of 50% hollow brick utilising contemporary, environmentally friendly, and energy-efficient technology. The Act offers both restrictive and prohibitive measures to stop environmental effects while taking into consideration air pollution and other environmental hazards. The Act limits brick output and the construction of brick kilns while imposing requirements since brick manufacture contributes to air pollution. The Act forbids the use of coal as fuel in brick kilns for burning bricks that contains sulphur, ash, mercury, or similar materials over the specified limit. The Act also forbids using fuel wood to burn bricks in brick kilns (GoB, 2013d).

5.5.11 Road Transportation Act, 2018

In line with the Environment Conservation Act of 1995, the Road Transport Act of 2018 enables the government to decide the number of emissions that can contaminate the environment. It expressly forbids the operation of any vehicle whose dangerous gas emissions exceed the governmental limit. Additionally, it forbids the installation or replacement of any machinery in the vehicle that pollutes the environment. The Act establishes various restrictions on the transportation of potentially hazardous explosive and combustible materials. It says that these products can be carried using the right packing, in particular cars, at times. However, the government has not yet developed the regulations that would further specify which cars or hours are involved. The most current Road Transport Act, 2018, also includes provisions for regulating the noise level in cars in addition to the Noise Pollution Control Rules, 2006. According to the Act, the government will decide the precise noise level for each region, and cars are not allowed to emit noise that is louder than that level. In the Act, using horns in quiet places has been expressly forbidden. The Act forbids the installation of any machinery in a vehicle that generates noise beyond the permitted level. However, it stipulates that the horn ban may be waived in the case of ambulance and firefighting vehicles if they adhere to the set limit in that respect (Solaiman et al., 2022).

5.5.12 National Environment Policy, 2018

After making changes to the 1992 policy considering the most recent environmental events on a local and global scale, including the insertion of Article 18A into the constitution, the government enacted the National Environment Policy (NEP) in 2018. The strategy has promised to combat air pollution with the finest tools at hand. Its objectives are to select the appropriate air management regions, establish environmental standards, and put applicable legislation into effect. Additionally, it suggests imposing an emission levy on polluting companies. The strategy advises that the conventional way of making bricks by burning the soil be replaced with contemporary sustainable technology, with an emphasis on the air pollution created by the brickkilns. The policy also addresses the pollution produced by the automobiles. It suggests that extra-sulphur coal should be regulated, all automobiles should have emission clearance certificates, and environmental standards should also be followed by ships, trains, and planes that are travelling within the nation. Controlling water contamination in the nation has been emphasised by the National Environment Policy. The policy has introduced Integrated Water Resources Management, which calls for the responsible use of all the nation's water resources, the creation of new industrial zones that consider the potential for polluted water discharge from industries, requiring industry owners to take action to clean up nearby reservoirs, monitoring water quality to prevent water pollution, observing inland waters to detect water pollution, and other measures. Garbage management is entrusted to local government organisations such the municipal corporation, Zila Parishad, Upazila Parishad, and Paurasava to reduce water contamination caused by waste. However, they are unable to carry out their responsibilities effectively (MoEF, 2018).

5.5.13 Air Pollution Control Rules

To safeguard environmental well-being, the GOB released the Air Pollution Control Rules, 2022 (SRO NO. 255-LAW/2022, Dated 25 July 2022), which derives their authority from section 20 of The Bangladesh Environment Conservation Act, 1995. These regulations primarily aim to prevent, control, and decrease air pollution by addressing different forms of pollution, such as those caused by factories, vehicles, and construction activities. The rules outline specific provisions that focus on the objective of controlling, preventing, and reducing air pollution.

To ensure the effective implementation of the Air Pollution Control Rules of 2022, the Director General (DG) of the Department of Environment (DoE) has been entrusted with various responsibilities. Under Rule 4, the DG is empowered to formulate a comprehensive national air quality management scheme aimed at reducing and controlling air pollution. Additionally, Rule 5 grants the DG the authority to designate an area as a 'Degraded Air Shed' when the air quality exceeds prescribed limits and becomes severely polluted.

To further support the enforcement of the rules, Rule 6 enables the DG to categorize activities responsible for air pollution. Rule 7 mentions that the DG or a person authorized by the DG shall identify the main source of air pollution and plan for its elimination. Control of air pollution from industrial establishments or projects; control of vehicle induced air pollution; the role of local government institutions and construction control corporations; the role of construction, renovation, and repair agencies or organisations, or individuals, and control of waste-related air pollution are all covered in Rules 8, 9, 10, 11, and 12, respectively. Rule 13 focused for establishment of Continuous Air Quality Monitoring Station, data analysis and forecasting. Rule14 ensure collected air quality data will be persevere for further research and it can disseminate to all either paid or free depend on data uses.

The establishment of a committee, as stipulated in Rule 15, comprising representatives from relevant ministries, organizations, and institutions, serves to provide guidance, advice, and recommendations regarding air pollution management. Non-compliance with the provisions outlined in the Air Pollution Control Rules of 2022 may result in penalties, including fines of up to 2 lacs and imprisonment of up to 2 years mentioned in Rule 16.

An innovative provision introduced in Rule 16 allows the government to recognize and award individuals or institutions that contribute to the control and preservation of air quality. Furthermore, the rules emphasize the importance of cooperation between government departments and organizations, including the DoE and local government, to ensure the maintenance of air quality and the prevention of air pollution.

5.5.14 Summary of Policy and Legal Documents of Pollution Control and Environmental Governance

Water Resource Planning Act, 1992	• to protect and betterment of the water resource and established WARPO as an authority.
Bangladesh Environmental Conservation Act, 1995	• Most important environmental law that completely strives to encourage environmetal stewerdship and pollution control
Water Supply and Sewerage Authority Act, 1996	• This act enacted to govern the sewage system and water supply
Environmental Conservation Rules, 1997	• This rule extensively mentioned about the air and noise pollution
Noise Pollution Control Rule, 2006	• Under the light of Environmental Conservation Act of 1995, this is the first rule which inacted the noise pollution regulation
Bangladesh Water Act, 2013	• First water oriented act and defined water pollution
Water Rules, 2018	• This rule enhanced water act 2013 where right to water has been discussed.
The Playgrounds, Open Spaces, Parks, and Natural Wetlands Conservation Act-2000	• This act aims to ensure the conservation of natural recreational areas and wetlands by prohibiting harmful activities and maintaining ecological balance
National River Conservation Commission Act, 2013	• Another river oriented act and established NRCC as an authority
Brick Manufacturing and Brick Kilns Establishment Act, 2013	• This act enabled the control of Brick Manufacturing industry, a major air pollutant.
Road Transportation Act, 2018	• Enacted via ECA 1995, this act limited the emmission level of various gases
National Environment Policy, 2018	• This is the most recent policy of Bangladesh, which has been upgraded with align to the global scenario
Draft Air Pollution Control Rules	• This rule will enact to control, reduce and prevent air pollution

Figure 111: Policy and legal framework of Pollution and environmental governance

From the figure, three distinguished point can be identified for further discussion. Firstly, these laws and policies have been established by various authorities especially for water scenario. But no specific authorities have been established for air and noise pollution. Bangladesh is still following the Bangladesh ECA of 1995, it is old act and needs serious improvisation as there are a lot of new establishments in environmental conservation discourse. Furthermore, it is also evident that air and noise pollution are getting attention recently, however, most of the policies are still in draft version or not acting properly. As our data suggests, it is crucial to enact these policies and laws in a quick approach and the older policies are in a need for revisions.

The research and analysis of legislation stated above explain that there are many laws and regulations addressing air, noise, and water pollution. However, there are still issues with how regulations that worsen environmental contamination are put into practise. It is stated that the legal system has been criticised for its ambiguity, consistency, procedural complexity, broad discretionary authority granted to the administration, lack of accountability, and obstacles to accessing the court system. The "To the Prime Minister: Save Rivers, Save Dhaka" campaign was launched in 2009 by the well-known TV network Channel-i and a well-known English daily newspaper. Due to pollution in the four rivers that surround the city of Dhaka, they introduced the critical condition. Based on this, officials acted right away and began action to reduce pollution. A substantial influence against the current pace of pollution, however, could not be made by sudden news and basic statistics. A National River Conservation Commission (NRCC) was established on February 3, 2019, to regulate and control river pollution considering the urgency and realisation that rivers are "legal entities" with rights comparable to those of living things (Uddin and Jeyong, 2021). A similar approach for air and noise is needed to control, prevent, and mitigate the pollution problem.

CHAPTER SIX: RECOMMENDATION AND CONCLUSION

There are many efforts to control environmental degradations. However, to make the city free from water, air and noise pollution, it requires all the stakeholders to come forward for bringing changes from all possible perspectives. This report can be a catalyst to accelerate the process of the positive transformation. If we fail to collaborate and adopt a multifaceted and comprehensive approach in addressing Dhaka's environmental challenges, we shall be unable to safeguard the vital lifelines of the city and overall environment of Dhaka. It is crucial for us to work together, leveraging various strategies and initiatives to protect the fundamental sources of life for the people and other living beings in a densely populated capital city.

6.1 Significant findings of the Study

Four locations were identified to be brought under the scientific analysis to check water pollutions to the Dhaka rivers considering three kinds of pollutions. To investigate water quality near the cluster of dyeing factories in Shyampur, pollutions from the naval vessels near Sadarghat Land Port and Hazaribag Old Tannery Park area, water from three points along the Buriganga River were examined along with water from a point in Dhaleshwari river near new Tannery Park in Hemayetpur by the WKB Consortium. From the test results, most of the parameters revealed higher than the standard value. In terms of pH, only Hazaribagh station showed the water level as neutral almost all the year. Hemayetpur has the highest average of Total Suspended Solids and Oxygen Demands Values. In the water quality indexing the worst water quality was found in Hemayetpur while Shyampur was the next. Sadarghat area found relatively better, which was also marginal in the CCME index and unusable. According to the data, the water of the Buriganga river in Dhaka had an extremely high level of heavy metal pollution. Most of the points in the rivers had low water quality scores on the CCME index. These were obvious indications of urban pollution, which had to be controlled for the protection of the public health and environment of Dhaka.

In terms of concentration of $PM_{2.5}$, the Parliament area had the lowest yearly concentration of $PM_{2.5}$ at 59.4 g/m3, while Shahbagh had the highest annual concentration at 91.4 g/m3. The yearly BD standard (15 g/m3) was exceeded by both samples by 4 and 6 times, respectively. The yearly mean concentration of 10 sites, however, was determined to be 73.1 g/m3, which was 4.9 times higher than the reference value. Winter was the worst out of the four seasons, followed by the other three and, in comparison, the monsoon season, although not a single sample site concentration was discovered to be within the acceptable range. Furthermore, $PM_{2.5}$ concentrations for all sampling sites manifested a different variation characteristic, different season have different hotspot of pollution. Among 10 locations minimum annual concentration found 87.6 $\mu g/m^3$ at Parliament area and maximum annual concentration of PM_{10} has been found in the 147.1 $\mu g/m^3$ at Shahbagh. However, both are 1.7 and 2.9 times higher than the annual BD standard (50 $\mu g/m^3$) respectively. On the other hand, annual mean concentration of 10 locations has been found 112.8 $\mu g/m^3$ which is 2.2 times higher than the standard. Among four season winter is the worse than others three and comparatively monsoon season are best but not a single sample site concentration found within standard.

As whole Dhaka city is considered a mixed area, 60dBA is the standard limit for daytime. Average 81.7% of time noise level exceeded the standard limit. Ranking based on 60dB Agargoan is the top noise polluted location, here noise level exceeds 87.9% of time. And least noise polluted location is Tejgaon, here noise level exceeds 73.6% of time. Difference between highest and lowest polluted locations is not much more. Sounds at or below 70 dBA are generally considered safe by U.S. Department of Health & Human Services. Analysis of data obtained from 10 places in Dhaka with compared with of 70 dB shows that, 50.2%-time noise level exceeds.

The perception of the civil society towards the water quality in the rivers around Dhaka made it essential to conduct evidence based anti-pollution campaigning and advocacy efforts. Community leaders and civil society representatives discussed various aspects of the river like the role of rivers for the women and youth, impact on health, related legal frameworks, urbanisation based on rivers, art & culture influenced by rivers etc. during various events and activities.

6.2 Recommendations

The study will draw conclusion with some sector-specific recommendations. The recommendations are briefly described in the following subsections.

6.2.1 Recommendations for Water Pollution Reduction

Results of water quality assessment showed that the water quality of Shyampur and Hemayetpur area were very bad. Pollutants from the Dyeing Factories and Tannery Industries need to be immediately stopped. On the other hand pollutants from Hazaribagh and Sadarghat area were also evident that suggested us to put attention of the pollutants coming from tannery related small and cottage industries along with the naval vessels. Polluted water should have caused severe damage to the aquatic habitats and vegetations in the floodplains. Non-biodegradable pollutants from various sources must be mixed with the water and food chain. It requires further in-depth study to expose the health and economic impacts.

City dwellers including the riverbank community are often ignored by the policy formation and implementing agencies that need to be more inclusive and transparent. City plans and projects should address related policies, legal frameworks, court orders and cultural heritage. The report draws some recommendations for reducing water pollution in the buriganga river. As water pollution can not be stopped in one day, there are some short term, mid term and long term recommendations for reducing water pollution.

6.2.1.1 Short Terms Strategies for Water Pollution Reduction

1. Pollution Mapping is the first step to start with for sorting out the character and cluster of the sources of pollution and preparing a comprehensive short term, midterm and long term plan of action.

1. Training, awareness and engagement of implementing agencies, polluting industries, particularly the owners of the Tannery and Dyeing factories along with the community and CSO are immediate steps to be undertaken to reduce pollution to Buriganga.
2. The government and development partners can enhance their support in research to develop appropriate technologies, equipments and periodic recommendations to reduce water pollution.
3. To stop construction of any structure for the time being within a certain distance of the riverbank and demarcate the river area as instructed by the court for evicting the Illegal occupancies including the industries that are grabbing river area and discharging pollutants to the rivers and connected canals.

6.2.1.2 Midterms Strategies for Water Pollution Reduction

1. To prepare various Action Plans for relocating, reusing or treating effluents at/from the source by addressing individually, in cluster or zone considering commercial viability of the process.
2. To customize and implement pay principles of polluters in various formats by joint collaborations with the business platforms and government agencies ensuring functional accountability mechanisms.
3. To adopt innovative plans and projects of government and development partners to stop pollution to the rivers, particularly from the canals that are carrying effluents to the rivers.
4. To survey the river area properly, to put up demarcation pillars, to evict illegal occupancies and to protect the river according to the court order.
5. To strengthen the National River Conservation Commission and National River Conservation act.

6.2.1.3 Long Terms Strategies for Water Pollution Reduction

1. To develop a strong monitoring and accountability mechanism that consists of science, data and all the stakeholders including the people from the respective riverbank community.
2. To put planned efforts to recover the foreshore, floodplains, canals and connected natural wetlands.
3. To make sure that any plans and projects should be developed protecting the ecology and biodiversity in an open approach instead of a commercial and conflicting approach with the natural architecture.
4. To ensure effluents to be treated at source and capacitate regulatory bodies with a functional accountability mechanism.
5. To establish inter-ministerial coordination and increase Budget Allocation for environmental protection
6. To ensure coherence and consistency among the relevant government policies, laws, ordinances and court orders.

6.2.2 Recommendations for Air Pollution Reduction

Recommendations for Air Pollution reduction has been described below in three different time spans.

6.2.2.1 Short Terms Strategies for Air Pollution Reduction

1) For personal protection from corrosion using improved quality, masks could be a temporary solution for the individuals.
2) Government can take the initiative to water the roads two times a day. Dhaka WASA, City Corporation, Fire service and DoE should co-operate each other as honourable High Court instructed to reduce air pollution.
3) Need proper solid waste management in Dhaka metropolitan area, to take compensation if anyone burns any solid waste or medical waste in an open place.
4) While doing construction, workplaces to be surrounded and construction materials to be covered during transportation. Government can use suction trucks and vacuum sweeping trucks instead of the manual broom to clean the road and collect road dust.
5) The government should take steps to shut down all illegal kilns operating without any license.
6) Personal car and unfit transportation to be controlled, if require car movement to be directed as per odd-even number plate of the vehicles.
7) To reduce air pollution, the coordination of governmental bodies is a mandatory task to perform.

6.2.2.2 Midterms Strategies for Air Pollution Reduction

1) Proper tree plantation with the help of Government and Non-government Institutions.
2) The number of surface water bodies should be increased.
3) The use of sand brick as an alternative to burnt bricks should be gradually increased.
4) The government may introduce more separate bicycle lanes for the city dwellers.
5) Regular inspection and enforcement programs should be conducted to audit the emission compliance of the brick kilns and outdated vehicles.

6.2.2.3 Long Term Strategies for Air Pollution Reduction

1) The Draft Clean Air Act-2019 needs to be approved and implemented as soon as possible.
2) The annual budget allocation of the Ministry of Environment needs to be increased to take initiative for environmental protection and create awareness.
3) Need to increase the CAMS station outside Dhaka for proving early warning system of Air Pollution.
4) The government can provide financial and technical support to the researcher to generate more data and evidence.
5) Make more awareness through print, electronic and social media.

6) Environmental cadre service in the Bangladesh Civil Service (BCS) can be introduced for sustainable solution to the air pollution.

6.2.3 Recommendations for Noise Pollution

We need to be aware of noise pollution created by ourselves. If we can change some of our habits, we will be able to keep ourselves and our surroundings better. We need to create awareness and provide education on the consequences of noise pollution. We should use lower sound volume while watching television, in wedding, social, political and religious ceremonies, so that it does not go out of the show premises. Everyone should be informed about the noise pollution rules and along with the need for proper planning and implementation of the law. The other steps can be-

1. Stop unnecessary and frequent honking of bikes, cars, buses and other vehicles.
2. Restrict the use of VIP / emergency horns.
3. Stop playing bands, bursting firecrackers at the wedding home parade.
4. Banning the use of hydraulic horns and any type of horn that makes loud noises in vehicles in Dhaka district.
5. Installing noise insulation in new buildings.
6. Creating pedestrian areas where traffic is only allowed to enter to offload goods at certain times.
7. Everyone should be informed about the noise pollution rules and along with the need for proper planning and implementation of the law in City level.

6.3 Conclusion

Dhaka rivers are completely dead during the lean period for any aquatic life to survive. Scientific analysis, community experience and civil society perception support this reality while the analysis of the legislative landscape and court orders reflect some endeavours of the government and court to tackle river pollutions. However, the pollutants have spread enough towards the floodplains and nearby agricultural lands that the contamination of toxic and carcinogenic chemicals should be existing in the food chain. The issues of public heath and economic impact of the pollutions to our river systems require deeper drive and credible research to identify more crucial crisis and remedies. Textile and Tannery, the two major polluting sectors to the Dhaka rivers can be brought under cluster effluent treatment facilities together with the regulators, polluters and sufferers. But any such transition needs a comprehensive and transparent roadmap that incorporates science and people at the core of the policy formation and implementation phases. Rivers are historically the face of every living being across the world while we made them some narrow drains to carry the industrial effluents mostly. We must change it. And to do that first we need to recognize the problem seriously and then to start working together with all relevant stakeholders including the woman, youth, media and development partners. On the other hand, it is not possible to eliminate Air and Noise pollutions in Dhaka completely. Some air pollutions happen naturally, and some are transboundary. But we can make significant improvement by introducing and promoting alternatives to bricks and regulating the transport and construction sectors wisely. For protecting and promoting health, sanity, and wellbeing of the existing city dwellers and for the future generation, it is time that we all take this problem into account and start working together to educate, aware and engage all stakeholders. This study urges to call for a collective approach in fighting environmental pollutions to save Dhaka and Bangladesh.

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Annex – A: Water Quality Dataset

Water Quality Data of 2022

	pH Level				TSS (Total Suspended Solids)				Chemical Oxygen Demand				Biological Oxygen Demand				Ammonia (NH3)			
	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS
Pre-monsoon	7.1	7	7.6	7.6	74	116	26	108	230	318	48	190	54	102	25	87	24	0.4	5.7	4.8
Monsoon	7	7	7.4	6.7	48	21	9	57	337	182	22	227	18	87	6	72	16	0.5	3.2	4.2
Post-monsoon	8.6	7	7.3	8.5	1091	84	41	195	2885	134	16	276	616	76	2	106	6.1	3.7	0.2	2.8
Dry	7.7	6.9	7.4	5.6	144	442	52	194	335	434	72	399	67	196	38	217	8.3	20	3.4	16
Average	7				10				10				0.2				0.2			

	Oil and Grease (OG)				Sulphides				Phenols				Cadmiums			
	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS
Pre-monsoon	1	6.8	0.5	2.6	0.6	0.7	0.6	0.7	0.156	0.121	0.56	0.14	0.001	0.001	0.001	0.001
Monsoon	0.9	1.6	0.5	1.9	0.14	0.81	0.01	13.2	0.68	0.172	0.068	0.435	0.001	0.001	0.001	0.001
Post-monsoon	6.3	8.5	0.5	5.6	1.67	0.08	0.05	1.8	0.395	0.03	0.02	0.2	0.001	0.001	0.001	0.001
Dry	0	3.1	1.1	41	0.25	1.05	0.13	0.71	0.41	0.166	0.046	0.259	0	0	0	0
Average	0.5				0				0.002				0.005			

Water Quality Data of 2023

	Ph				TSS				COD				BOD				NH3			
	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS
Pre-Monsoon	7.9	7.4	7.3	8.3	23	67	123	140	70	99	56	331	9	41	19	172	17	24	17	19
Monsoon	0	7.1	7.1	7.1	36	0	81	24	24	81	0	36	3	7	2	9	0	0	0.4	0.3
Post-Monsoon	7.1	7	7.1	7.2	27	21	32	24	24	81	0	36	30	3	16	19	0	0	0.4	0.3
Winter	6.8	7.3	6.7	6.8	36	49	8	57	68	91	17	47	9	42	7	14	7.5	9.3	2.3	2.6
Average	5.45	7.2	7.05	7.35	30.5	34.25	61	61.25	46.5	88	18.25	112.5	12.75	23.25	11	53.5	6.125	8.325	5.025	5.55

	O&G			S2					C6H6O				Cd			
	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS	NTI	OTI	SS	SDS
Pre-Monsoon	0	2.9	8.1	28	0.13	1.07	0.08	0.96	0.094	0.126	0.068	0.1	0	0	0	0
Monsoon	0	0	0	0	0.09	0.06	0.1	0.07	0.013	0.001	0.012	0.014	0	0	0	0
Post-Monsoon	0	0	0	0	0.09	0.06	0.1	0.07	0.013	0.001	0.012	0.014	0	0	0	0
Winter	0	1.3	2.1	0.7	0.09	0.2	0	0	0.116	0.063	0.024	0.034	0	0	0	0
Average	0	1.05	2.55	7.175	0.1	0.3475	0.07	0.275	0.059	0.04775	0.029	0.0405	0	0	0	0

Annex – B: Air Quality and Noise Level Dataset

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 5 to 30 April 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	5/Apr/2021	Ahsan Manzil	57	294	112.18	37	226	57.27	17	167	31.88	60	124.4	74.14
2	5/Apr/2021	Motijheel	62	810	164.45	44	724	99.40	21	192	47.92	47.2	117.2	73.44
3	6/Apr/2021	Shahbag	72	760	244.20	48	749	173.40	27	373	78.08	58.5	123	75.64
4	6/Apr/2021	Dhanmondi-32	77	706	149.24	56	353	80.79	23	55	34.66	53.3	117.6	74.62
5	7/Apr/2021	Parliament Area	63	914	218.50	48	939	174.68	23	488	105.29	39.8	125.5	65.19
6	7/Apr/2021	Tejgaon	46	451	135.82	40	459	107.15	22	217	52.75	53	101.7	63.82
7	8/Apr/2021	Agargaon	72	416	168.70	46	304	76.43	26	54	38.35	61.4	127.6	76.59
8	8/Apr/2021	Mirpur-10	122	822	284.39	60	385	91.88	32	120	43.63	67.8	128.6	81.52
9	9/Apr/2021	Gulshan-2	55	1252	126.85	44	675	99.25	23	70	39.04	53	99.9	71.63
10	9/Apr/2021	Uttara-Abdullahpur	27	985	159.98	28	939	119.18	29	107	60.35	63.5	129.6	79.65
11	11/Apr/2021	Gulshan-2	56	1024	154.10	49	395	101.62	34	161	51.69	55.3	117	76.96
12	11/Apr/2021	Uttara-Abdullahpur	63	2569	224.35	61	504	114.92	34	156	55.56	62.2	122.3	73.12
13	12/Apr/2021	Agargaon	66	1696	158.05	48	468	97.49	42	276	90.08	61.7	126.9	76.80
14	12/Apr/2021	Mirpur-10	61	2224	224.03	47	1005	93.20	36	204	83.66	59.8	120.9	77.32
15	13/Apr/2021	Parliament Area	4	422	71.67	4	434	54.99	25	46	34.70	53.2	120.9	72.01
16	13/Apr/2021	Tejgaon	15	1120	123.72	16	171	70.42	24	73	34.50	46.8	126.3	67.45
17	15/Apr/2021	Ahsan Manzil	49	588	91.07	45	345	71.20	22	49	34.25	39.5	103.6	66.60
18	15/Apr/2021	Motijheel	12	723	70.20	12	753	51.16	21	42	29.87	49.3	106.9	73.30
19	16/Apr/2021	Shahbag	30	321	61.01	24	80	40.76	20	75	34.44	48.9	129.7	71.30
20	16/Apr/2021	Dhanmondi-32	29	1205	100.01	28	1171	63.75	23	55	34.24	42.3	129.6	71.32
21	17/Apr/2021	Agargaon	48	188	102.87	43	134	80.46	36	72	44.70	54.3	90.9	67.03
22	17/Apr/2021	Mirpur-10	40	564	85.88	36	585	61.61	37	58	45.37	52	130	66.58
23	18/Apr/2021	Parliament Area	23	773	56.82	23	129	37.24	27	47	35.29	43.3	129.4	72.42
24	18/Apr/2021	Tejgaon	37	273	70.27	32	282	53.72	25	39	31.00	53.6	117.8	68.30
25	20/Apr/2021	Agargaon	44	143	64.28	30	50	36.11	13	21	17.41	64.4	109.5	69.98
26	20/Apr/2021	Mirpur-10	38	488	75.51	32	207	43.55	22	31	24.62	51.3	103.2	71.21
27	21/Apr/2021	Gulshan-2	36	130	59.67	36	99	51.95	26	60	43.00	44.8	113.2	62.62
28	21/Apr/2021	Uttara-Abdullahpur	47	191	81.94	41	128	65.00	41	53	47.00	52.2	127.7	67.20
29	22/Apr/2021	Ahsan Manzil	48	378	125.70	37	240	84.76	38	47	42.50	41.7	130.2	69.95
30	22/Apr/2021	Motijheel	85	363	129.96	76	214	99.47	38	47	42.50	46.2	130	69.92

31	23/Apr/2021	Parliament Area	32	211	63.05	21	71	46.93	24	39	31.50	40.3	131.1	63.85
32	23/Apr/2021	Tejgaon	55	712	133.95	35	737	96.61	28	37	32.50	51.4	91.9	66.55
33	25/Apr/2021	Shahbag	47	2854	277.34	33	517	71.79	19	41	30.00	53.8	128.9	73.19
34	25/Apr/2021	Dhanmondi-32	58	2842	236.87	38	785	85.67	19	300	70.45	49.3	125.9	70.83
35	26/Apr/2021	Agargaon	45	229	80.97	30	233	49.59	27	45	36.00	50.2	127.5	66.57
36	26/Apr/2021	Mirpur-10	13	661	133.12	13	688	104.05	22	31	24.62	39.7	127.1	62.05
37	27/Apr/2021	Uttara-Abdullahpur	25	177	74.03	22	101	43.58	21	32	26.50	52.4	114.6	67.96
38	27/Apr/2021	Gulshan-2	36	130	59.67	36	99	51.95	21	34	27.50	44.1	129	70.01
39	28/Apr/2021	Parliament Area	58	777	98.40	52	187	71.43	55	72	63.79	39.6	130	65.93
40	28/Apr/2021	Tejgaon	74	278	132.26	61	164	102.28	50	65	59.91	43.4	115.3	61.25
41	29/Apr/2021	Shahbag	29	815	105.22	30	849	84.74	41	57	46.95	45.5	106.6	67.84
42	29/Apr/2021	Dhanmondi-32	37	873	74.01	34	903	65.05	43	63	52.00	48.2	116.1	65.55
43	30/Apr/2021	Ahsan Manzil	61	1173	170.35	51	750	106.11	44	61	50.00	51.3	131.5	74.04
44	30/Apr/2021	Motijheel	62	825	144.05	61	667	120.37	45	59	48.25	45	129.3	72.15
		Average	48.09	803.41	129.06	38.36	452.23	80.75	29.23	99.80	45.19	50.78	120.13	70.35

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 1 to 27 May 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	1/May/2021	Gulshan-2	53	768	130.13	49	220	82.63	26	74	38.37	47.3	131.9	78.91
2	1/May/2021	Uttara-Abdullahpur	57	177	79.52	50	81	63.50	31	46	35.50	36.2	99.3	56.06
3	2/May/2021	Agargaon	37	1926	128.76	27	372	65.97	45	100	55.20	54.2	131.4	77.10
4	2/May/2021	Mirpur-10	48	498	129.32	41	397	84.85	37	100	69.30	47.1	129.2	73.11
5	4/May/2021	Ahsan Manzil	41	581	119.58	41	508	69.04	38	101	49.10	40.4	113.2	69.29
6	4/May/2021	Motijheel	31	1478	186.06	29	653	124.47	87	99	89.20	43.8	110.3	74.66
7	5/May/2021	Parliament Area	54	746	111.09	44	398	81.04	25	47	34.91	49.5	123.7	69.27
8	5/May/2021	Tejgaon	26	561	108.40	27	585	95.72	29	46	37.20	57	95.4	67.62
9	7/May/2021	Uttara-Abdullahpur	63	914	218.50	48	939	174.68	23	488	105.29	39.8	125.5	65.19
10	7/May/2021	Gulshan-2	46	451	135.82	40	459	107.15	22	217	52.75	53	101.7	63.82
11	8/May/2021	Agargaon	72	416	168.70	46	304	76.43	26	54	38.35	61.4	127.6	76.59
12	8/May/2021	Mirpur-10	122	822	284.39	60	385	91.88	32	120	43.63	67.8	128.6	81.52
13	9/May/2021	Tejgaon	55	1252	126.85	44	675	99.25	23	70	39.04	53	99.9	71.63
14	9/May/2021	Parliament Area	27	985	159.98	28	939	119.18	29	107	60.35	63.5	129.6	79.65
15	11/May/2021	Shahbag	56	1024	154.10	49	395	101.62	34	161	51.69	55.3	117	76.96
16	11/May/2021	Dhanmondi-32	63	2569	224.35	61	504	114.92	34	156	55.56	62.2	122.3	73.12
17	12/May/2021	Gulshan-2	66	1696	158.05	48	468	97.49	42	276	90.08	61.7	126.9	76.80
18	12/May/2021	Uttara-Abdullahpur	61	2224	224.03	47	1005	93.20	36	204	83.66	59.8	120.9	77.32
19	15/May/2021	Tejgaon	18	532	109.69	9	558	94.03	36	60	41.04	51.8	116.5	68.16
20	15/May/2021	Parliament Area	18	812	128.16	16	840	118.38	30	59	34.91	53	126.9	70.23
21	16/May/2021	Agargaon	11	123	27.12	10	92	14.81	9	57	11.52	49.3	128.1	69.46
22	16/May/2021	Mirpur-10	22	1278	164.96	17	790	126.35	41	330	122.43	51	130.5	70.24
23	17/May/2021	Dhanmondi-32	8	417	52.70	6	261	41.03	13	60	36.17	45.4	130.7	71.99
24	17/May/2021	Shahbag	17	598	109.16	12	627	104.00	23	63	38.86	49.3	130.2	65.04
25	18/May/2021	Motijheel	13	404	42.45	12	144	22.62	17	61	19.08	50.3	129.6	71.78
26	18/May/2021	Ahsan Manzil	9	618	75.35	9	643	70.42	13	49	22.56	50.8	95.6	65.20
27	19/May/2021	Agargaon	21	868	73.76	18	891	64.19	17	34	23.96	64.6	73.2	68.22
28	19/May/2021	Mirpur-10	28	734	59.11	27	753	46.63	12	30	18.63	72.1	88.2	79.10
29	20/May/2021	Dhanmondi-32	10	418	60.88	9	365	44.65	12	33	22.12	64.4	92.5	73.28
30	20/May/2021	Shahbag	19	698	136.93	20	727	130.33	6	20	10.42	65.7	87	72.33
31	21/May/2021	Tejgaon	15	608	120.91	8	633	93.25	14	36	26.00	56.1	84.7	66.22
32	21/May/2021	Parliament Area	10	693	76.47	7	717	47.70	13	28	17.71	62.3	81.3	69.98
33	22/May/2021	Ahsan Manzil	13	958	101.12	9	420	51.55	13	26	18.96	64.5	85.4	72.45

34	22/May/2021	Motijheel	10	465	68.04	10	483	55.11	12	41	21.13	66.8	82.1	72.19
35	23/May/2021	Uttara-Abdullahpur	39	695	123.68	35	392	80.27	32	60	38.67	78	84	80.93
36	23/May/2021	Gulshan-2	35	514	117.05	32	535	104.98	36	52	43.21	59.7	75.9	67.45
37	24/May/2021	Tejgaon	29	395	85.87	21	290	57.40	10	34	23.13	63	74.7	66.91
38	24/May/2021	Parliament Area	21	901	57.10	18	223	32.00	6	48	20.46	65.3	81.6	72.58
39	25/May/2021	Shahbag	2	698	164.90	3	727	146.28	4	13	6.71	68.7	95.6	81.02
40	25/May/2021	Dhanmondi-32	8	125	18.32	7	130	12.59	5	12	7.54	62.9	87.1	72.83
41	26/May/2021	Ahsan Manzil	27	458	79.78	19	344	60.67	7	53	27.96	69.3	89.3	76.38
42	26/May/2021	Motijheel	31	476	87.71	20	496	73.38	12	50	21.04	58.1	65.9	60.36
43	27/May/2021	Uttara-Abdullahpur	26	457	103.46	17	390	64.42	15	60	24.83	74.6	97.8	85.93
44	27/May/2021	Gulshan-2	21	552	92.17	14	510	62.19	14	41	21.08	62.5	86.2	71.15
		Average	33.16	785.98	117.83	26.45	506.09	80.96	23.66	88.09	39.76	57.56	105.34	72.05

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 1 to 27 June 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	1-Jun-21	Mirpur-10	20	481	76.23	17	502	73.80	12	37	26.83	48.1	128.9	75.46
2	1-Jun-21	Agargaon	28	447	121.23	28	462	99.68	21	26	23.38	49.2	120.6	71.11
3	2-Jun-21	Shahbag	24	601	160.40	22	150	41.35	21	38	25.75	35.7	130.6	75.90
4	2-Jun-21	Dhanmondi-32	23	148	49.02	23	143	34.00	7	37	24.04	48.8	129.4	76.88
5	3-Jun-21	Ahsan Manzil	30	584	109.83	27	437	88.58	18	42	24.00	50.2	130.8	72.21
6	3-Jun-21	Motijheel	29	311	57.41	23	323	45.34	19	40	26.96	48.2	128.5	78.61
7	5-Jun-21	Gulshan-2	11	270	139.74	10	224	109.69	26	113	67.79	55.5	126.5	73.38
8	5-Jun-21	Uttara-Abdullahpur	22	371	80.26	23	261	59.22	19	40	26.96	37.7	128.5	77.58
9	6-Jun-21	Agargaon	31	235	92.36	30	191	80.22	44	53	48.63	60.7	124.9	74.61
10	6-Jun-21	Mirpur-10	34	156	58.39	35	163	57.19	38	55	46.13	73.1	127.6	84.68
11	7-Jun-21	Parliament Area	29	287	60.95	28	178	38.52	29	48	25.40	62.9	99.3	75.30
12	7-Jun-21	Tejgaon	19	388	53.07	20	403	45.56	29	77	32.34	49.1	98.8	66.06
13	9-Jun-21	Motijheel	12	428	49.67	12	433	46.67	22	100	32.70	65.6	125.4	81.54
14	9-Jun-21	Ahsan Manzil	35	374	87.16	36	388	75.50	30	137	53.58	64.2	125.2	78.47
15	10-Jun-21	Parliament Area	27	405	60.31	21	245	40.94	26	65	40.83	60.6	130.6	76.60
16	10-Jun-21	Tejgaon	15	358	64.51	15	375	50.65	17	31	22.50	52.7	129.2	70.75
17	11-Jun-21	Agargaon	11	1109	72.41	8	242	21.56	15	46	18.30	54	127.1	70.43
18	11-Jun-21	Mirpur-10	8	701	124.63	8	733	126.46	41	68	50.29	53.9	129.8	78.87
19	13-Jun-21	Gulshan-2	4	923	65.69	4	912	47.29	16	70	26.00	49	129.2	75.29
20	13-Jun-21	Uttara-Abdullahpur	29	1057	149.26	13	378	53.44	22	124	51.08	49.5	131.3	80.67
21	14-Jun-21	Shahbag	11	284	60.32	9	280	40.72	23	52	35.31	49.5	119.6	73.35
22	14-Jun-21	Dhanmondi-32	17	1733	120.90	14	1278	106.79	32	60	45.50	37.2	124.4	71.58
23	15-Jun-21	Uttara-Abdullahpur	20	633	72.92	16	255	39.75	16	45	21.75	36.4	130.2	76.32
24	15-Jun-21	Gulshan-2	10	225	49.63	11	112	27.89	12	30	18.50	55.8	121.8	74.69
25	16-Jun-21	Mirpur-10	25	293	80.79	21	155	42.22	18	44	27.08	40.1	127.9	80.23
26	16-Jun-21	Agargaon	26	197	51.55	20	75	37.18	18	24	20.29	41	128.6	68.90
27	18-Jun-21	Tejgaon	15	487	83.96	11	508	78.61	8	17	11.87	50.8	116.7	66.69
28	18-Jun-21	Parliament Area	5	723	59.38	4	748	45.05	8	14	11.54	57	128.5	76.44
29	19-Jun-21	Dhanmondi-32	14	205	48.12	14	208	40.72	25	50	39.29	39.3	128	60.13
30	19-Jun-21	Shahbag	3	186	38.03	4	194	37.87	14	183	29.29	53.3	128.3	77.11
31	20-Jun-21	Motijheel	20	228	40.57	14	234	34.98	27	174	26.60	66.6	111	78.36
32	20-Jun-21	Ahsan Manzil	5	1878	139.89	5	1027	125.19	30	239	83.13	46.4	128.6	71.48
33	22-Jun-21	Agargaon	16	222	66.64	17	187	59.70	12	67	30.42	49.5	103.5	68.99

34	22-Jun-21	Mirpur-10	37	160	75.28	23	141	53.11	17	90	39.33	72.4	130.3	85.57
35	23-Jun-21	Parliament Area	26	151	67.22	18	101	38.38	12	26	17.57	59.9	99.1	72.50
36	23-Jun-21	Tejgaon	19	191	48.22	16	196	35.02	9	20	16.88	53.4	98.6	69.93
37	24-Jun-21	Shahbag	20	371	51.08	10	155	20.93	11	19	14.13	62.7	98.6	73.53
38	24-Jun-21	Dhanmondi-32	16	119	37.91	7	54	17.08	7	17	11.63	56	102.7	69.84
39	25-Jun-21	Ahsan Manzil	25	552	62.62	15	112	28.13	8	13	10.04	45.5	131.3	70.73
40	25-Jun-21	Motijheel	31	151	75.44	15	83	43.25	12	28	20.13	59	129.8	73.21
41	26-Jun-21	Gulshan-2	13	174	69.15	12	172	35.24	17	37	23.50	52.7	127.4	78.21
42	26-Jun-21	Uttara-Abdullahpur	34	625	99.75	21	106	49.08	17	37	26.83	66.9	113	78.67
43	27-Jun-21	Parliament Area	21	94	44.43	11	47	19.28	8	93	17.17	60.6	96.2	68.58
44	27-Jun-21	Tejgaon	16	393	47.69	11	59	18.08	9	18	12.13	61.9	105.3	73.26
		Average	20.14	452.48	75.55	16.41	309.77	52.50	19.14	60.09	29.62	53.24	121.17	74.38

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 8 to 29 July 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	8-Jul-21	Agargaon	16	211	47.23	13	61	31.63	12	25	15.00	55.2	129.1	74.40
2	8-Jul-21	Mirpur-10	11	766	64.94	11	797	53.04	10	14	11.96	45.8	126.6	71.44
3	9-Jul-21	Tejgaon	18	766	68.89	15	797	55.98	15	46	19.96	47	124.1	68.05
4	9-Jul-21	Parliament Area	15	212	46.41	15	105	33.67	14	35	18.63	43.3	87.5	58.93
5	10-Jul-21	Shahbag	18	408	72.84	17	424	50.46	16	40	27.13	52.6	125.3	75.79
6	10-Jul-21	Dhanmondi-32	19	85	45.25	19	74	39.47	13	34	20.00	45.1	96.7	58.46
7	11-Jul-21	Ahsan Manzil	9	285	57.18	7	259	24.75	7	53	17.38	56.8	128.4	73.53
8	11-Jul-21	Motijheel	12	1058	49.18	11	262	25.39	9	22	16.50	45	129.2	77.56
9	12-Jul-21	Gulshan-2	15	1890	153.03	8	1363	118.56	5	35	12.30	48.8	129.9	74.18
10	12-Jul-21	Uttara-Abdullahpur	30	2174	122.32	22	481	51.27	8	40	15.80	44.3	129.3	73.62
11	13-Jul-21	Shahbag	5	321	49.80	3	97	18.18	2	50	14.50	55.1	102.5	72.56
12	13-Jul-21	Dhanmondi-32	3	597	14.89	2	77	4.70	1	16	3.13	53.8	119.3	66.36
13	14-Jul-21	Tejgaon	11	1397	114.85	5	1104	32.97	5	32	13.92	48.7	121	73.56
14	14-Jul-21	Parliament Area	13	241	48.42	7	165	18.08	2	11	6.17	59.5	95.2	72.90
15	15-Jul-21	Ahsan Manzil	1	662	51.70	1	123	16.81	8	21	15.13	52.5	130.6	75.15
16	15-Jul-21	Motijheel	12	340	29.61	6	73	13.18	3	28	8.67	46.9	130.2	70.37
17	16-Jul-21	Agargaon	9	834	151.49	7	451	68.04	9	30	13.46	48.7	127.1	75.62
18	16-Jul-21	Mirpur-10	4	542	71.38	4	554	32.82	2	18	12.38	45	123.4	77.16
19	17-Jul-21	Gulshan-2	11	208	50.45	10	195	32.97	15	49	18.65	62.8	129.2	82.61
20	17-Jul-21	Uttara-Abdullahpur	19	2606	113.15	9	758	51.81	20	41	24.88	69.9	117.9	84.78
21	18-Jul-21	Shahbag	7	1982	77.64	6	1071	47.03	19	43	27.88	60.6	124.6	73.40
22	18-Jul-21	Dhanmondi-32	9	122	20.00	9	127	15.15	6	18	10.42	53.6	98.8	68.32
23	19-Jul-21	Agargaon	12	170	41.26	12	84	26.90	7	20	15.75	53.8	124	71.23
24	19-Jul-21	Mirpur-10	50	574	128.15	20	373	65.75	21	41	28.79	39.4	126.7	79.00
25	20-Jul-21	Ahsan Manzil	6	69	19.19	6	68	17.33	7	12	9.21	47.3	104.5	66.58
26	20-Jul-21	Motijheel	2	79	19.21	3	64	18.11	10	24	14.42	61	124.5	74.49
27	21-Jul-21	Shahbag	8	33	14.69	8	25	12.28	5	9	6.70	54.8	94.6	64.59
28	21-Jul-21	Dhanmondi-32	9	682	23.98	8	251	14.89	6	9	7.71	49.6	89.3	64.33
29	22-Jul-21	Parliament Area	4	25	9.65	4	13	6.56	4	9	5.25	48.5	89.4	60.38
30	22-Jul-21	Tejgaon	3	57	12.33	2	58	6.41	5	17	6.12	52.6	117.3	64.48
31	23-Jul-21	Agargaon	9	789	21.08	5	207	8.80	3	15	8.71	43.1	120.9	59.84
32	23-Jul-21	Mirpur-10	9	789	21.08	5	207	8.80	5	24	6.10	38.5	114.9	70.96
33	24-Jul-21	Uttara-Abdullahpur	3	34	9.26	3	18	7.73	2	5	3.54	60.8	93.5	70.91
34	24-Jul-21	Gulshan-2	4	84	13.15	4	87	8.91	2	8	4.29	46.2	125.5	69.18

35	25-Jul-21	Tejgaon	23	199	43.65	13	205	25.55	4	8	5.84	42.8	129.5	72.30
36	25-Jul-21	Parliament Area	11	267	31.94	9	276	19.06	11	19	14.88	49.7	128.1	67.50
37	26-Jul-21	Dhanmondi-32	8	893	97.10	8	657	90.37	9	12	10.46	53.8	96.4	65.06
38	26-Jul-21	Shahbag	13	79	32.21	8	62	16.28	9	14	11.71	55.1	102.5	71.72
39	27-Jul-21	Uttara-Abdullahpur	4	332	21.75	3	209	10.20	3	9	5.46	42.8	129.5	72.30
40	27-Jul-21	Gulshan-2	3	339	16.34	3	168	9.89	1	6	2.67	49.7	128.1	67.50
41	28-Jul-21	Agargaon	4	328	17.78	4	344	12.45	3	6	4.42	53.8	96.6	67.04
42	28-Jul-21	Mirpur-10	4	60	10.39	4	38	7.90	3	6	4.42	44.3	124.2	57.26
43	29-Jul-21	Ahsan Manzil	5	108	14.16	6	112	13.51	5	8	6.29	47	107.5	71.64
44	29-Jul-21	Motijheel	3	220	17.74	3	125	12.45	3	13	8.42	56.7	99	74.80
		Average	10.55	543.57	49.02	7.91	297.02	28.55	7.48	22.61	12.16	50.73	115.74	70.50

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 1 to 26 August 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	1-Aug-21	Dhanmondi-32	5	61	26.76	6	40	26.04	9	19	12.84	45.5	127.4	69.32
2	1-Aug-21	Shahbag	23	75	29.50	23	78	29.24	10	23	16.52	59.1	109.9	71.92
3	2-Aug-21	Ahsan Manzil	21	200	42.00	20	208	36.79	22	47	27.13	61.9	98.5	70.87
4	2-Aug-21	Motijheel	3	312	29.63	3	83	25.50	21	38	23.12	46.5	125.7	73.78
5	3-Aug-21	Tejgaon	23	199	50.02	21	81	38.25	21	47	28.29	56.1	95.7	66.50
6	3-Aug-21	Parliament Area	11	363	57.03	11	369	39.28	22	32	26.38	44.9	128.2	73.24
7	4-Aug-21	Mirpur-10	26	421	75.17	18	167	40.87	9	36	20.12	56.4	103.8	70.36
8	4-Aug-21	Agargaon	14	713	137.49	14	153	39.60	6	24	16.29	58.2	125.6	74.49
9	6-Aug-21	Gulshan-2	44	179	105.04	35	141	79.23	20	45	35.25	47.4	98.9	64.59
10	6-Aug-21	Uttara-Abdullahpur	0	785	47.38	0	160	24.26	2	27	22.42	44.9	128.2	71.48
11	7-Aug-21	Ahsan Manzil	18	300	43.90	17	125	29.81	12	16	13.79	48.9	127.5	75.39
12	7-Aug-21	Motijheel	13	101	27.19	12	95	25.85	8	31	14.42	57.9	94.4	71.60
13	8-Aug-21	Dhanmondi-32	14	56	26.70	15	55	23.98	7	10	8.83	53.4	98.3	67.54
14	8-Aug-21	Shahbag	14	785	27.75	14	136	20.02	15	32	18.30	44	128.3	66.53
15	9-Aug-21	Gulshan-2	43	1386	104.50	42	1231	91.09	19	45	28.42	40.5	128.2	67.15
16	9-Aug-21	Uttara-Abdullahpur	36	413	84.08	35	81	47.46	19	32	24.13	67.8	116.6	77.84
17	11-Aug-21	Dhanmondi-32	2	300	35.10	2	142	28.34	17	24	20.21	39.6	129.1	68.63
18	11-Aug-21	Shahbag	1	588	56.04	1	200	45.63	24	37	28.92	49	130.7	74.30
19	12-Aug-21	Ahsan Manzil	3	224	22.43	3	60	14.75	10	28	11.57	49.3	127.5	76.17
20	12-Aug-21	Motijheel	23	499	85.89	22	136	44.65	15	37	21.96	59	127.4	78.25
21	13-Aug-21	Mirpur-10	45	239	64.26	46	140	62.75	23	42	29.88	49.3	127.5	78.04
22	13-Aug-21	Agargaon	45	239	64.26	46	140	62.75	29	53	36.50	46.1	118.2	69.69
23	14-Aug-21	Tejgaon	9	732	61.97	10	412	55.28	21	44	31.58	43.6	99.3	58.47
24	14-Aug-21	Parliament Area	13	163	45.68	7	162	16.70	11	44	12.15	48.4	126.2	68.39
25	16-Aug-21	Ahsan Manzil	12	105	40.82	8	85	24.04	13	44	17.49	44.5	126.1	62.62
26	16-Aug-21	Motijheel	12	105	38.32	8	85	22.83	16	45	18.42	52.2	129.1	79.15
27	17-Aug-21	Dhanmondi-32	6	207	45.85	6	99	30.96	6	15	9.25	52.3	100.4	67.41
28	17-Aug-21	Shahbag	13	524	52.80	11	289	34.01	14	40	27.46	52.8	125.5	78.24
29	18-Aug-21	Gulshan-2	1	251	40.36	1	176	19.81	5	8	6.29	44.9	129.3	74.55
30	18-Aug-21	Uttara-Abdullahpur	2	1237	38.48	2	317	25.44	11	27	18.04	43	126.1	78.59
31	19-Aug-21	Mirpur-10	11	713	89.55	7	343	32.80	6	83	17.08	55.7	126.5	82.58
32	19-Aug-21	Agargaon	10	112	34.73	6	88	12.99	3	43	7.04	61.2	94.9	72.42
33	20-Aug-21	Tejgaon	3	608	31.61	3	96	16.88	13	20	16.76	43.6	130.2	68.88
34	20-Aug-21	Parliament Area	3	344	22.31	3	307	12.95	2	8	4.71	40.9	122.9	65.75

35	21-Aug-21	Ahsan Manzil	18	342	51.99	9	60	20.56	6	20	12.79	61.5	127.4	77.69
36	21-Aug-21	Motijheel	8	135	31.17	7	140	19.67	5	26	10.52	49	112.9	68.34
37	22-Aug-21	Tejgaon	14	334	40.94	7	68	22.62	11	32	18.51	45.4	119	63.63
38	22-Aug-21	Parliament Area	2	119	28.62	3	122	18.45	9	39	15.49	43.6	130.2	74.63
39	24-Aug-21	Gulshan-2	34	107	50.57	34	111	45.22	27	36	30.58	53.4	127.6	67.52
40	24-Aug-21	Uttara-Abdullahpur	25	320	83.21	25	197	47.05	21	29	24.25	43.6	130.2	74.64
41	25-Aug-21	Mirpur-10	54	170	73.43	56	177	73.89	32	56	38.42	46.8	130.2	76.33
42	25-Aug-21	Agargaon	42	158	71.53	42	95	57.69	27	49	33.83	54.7	120.1	72.33
43	26-Aug-21	Tejgaon	4	457	65.57	4	480	60.93	30	43	37.17	42.5	99	70.25
44	26-Aug-21	Parliament Area	15	254	41.56	14	110	25.17	11	35	19.46	43.6	130.2	74.47
		Average	16.77	362.16	52.80	15.43	182.73	35.73	14.55	34.34	20.74	49.84	119.52	71.69

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 3 to 24 September 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	3-Sep-21	Agargaon	12	318	87.14	11	121	26.62	10	19	12.46	61.4	131.4	77.91
2	3-Sep-21	Mirpur-10	4	1900	149.67	4	450	87.04	17	56	27.83	57.4	123	77.17
3	4-Sep-21	Tejgaon	49	389	81.00	49	405	78.31	41	49	44.92	55.6	124.3	64.98
4	4-Sep-21	Parliament Area	58	742	120.45	57	764	89.39	38	53	45.54	51.9	130.2	75.85
5	5-Sep-21	Shahbag	29	358	89.08	31	376	79.78	35	55	47.25	43.1	102.4	72.60
6	5-Sep-21	Dhanmondi-32	20	286	72.10	16	295	72.58	42	63	50.04	49	127.1	69.71
7	6-Sep-21	Motijheel	8	91	32.02	7	67	20.49	12	18	14.00	51.5	129.6	72.79
8	6-Sep-21	Ahsan Manzil	7	694	63.78	5	133	22.53	10	14	11.54	40.4	113.2	68.65
9	7-Sep-21	Uttara-Abdullahpur	4	1681	86.81	4	344	35.00	13	21	16.71	54.8	122.8	75.26
10	7-Sep-21	Gulshan-2	13	1185	96.24	8	200	31.48	5	34	21.04	44.8	130.7	72.22
11	8-Sep-21	Agargaon	5	315	50.47	5	110	14.46	5	9	6.46	55.1	92.8	65.94
12	8-Sep-21	Mirpur-10	5	210	62.75	5	99	30.98	18	36	26.96	53.4	129	79.68
13	9-Sep-21	Parliament Area	11	1224	93.27	11	1228	86.56	17	38	24.13	31.68	119.5	73.34
14	9-Sep-21	Tejgaon	19	285	63.93	16	141	39.99	15	30	21.71	53.4	98.6	68.58
15	10-Sep-21	Dhanmondi-32	4	62	19.58	4	65	16.25	5	9	7.33	52.5	99.7	67.21
16	10-Sep-21	Shahbag	4	571	79.13	4	91	23.95	8	12	9.33	46.4	125.8	66.91
17	11-Sep-21	Ahsan Manzil	17	1899	136.73	9	524	52.76	8	49	19.58	59.2	129.9	74.74
18	11-Sep-21	Motijheel	24	179	71.14	16	150	46.90	17	83	29.58	62.9	99.9	73.96
19	12-Sep-21	Gulshan-2	15	187	49.30	7	191	23.32	4	43	10.88	57.2	123.1	75.32
20	12-Sep-21	Uttara-Abdullahpur	12	1261	150.19	6	544	42.33	5	17	9.48	45.3	129.5	76.72
21	13-Sep-21	Parliament Area	12	265	43.70	8	185	26.00	4	8	5.63	53.1	116.7	67.58
22	13-Sep-21	Tejgaon	25	265	52.31	15	54	22.47	8	20	10.96	60.6	130.6	76.45
23	14-Sep-21	Shahbag	7	559	64.89	5	583	59.32	17	284	41.40	48.5	126.8	74.69
24	14-Sep-21	Dhanmondi-32	6	110	51.48	5	87	35.46	18	33	29.88	51.1	116.1	67.22
25	15-Sep-21	Ahsan Manzil	10	556	37.07	5	165	16.81	4	8	6.13	56.9	119.5	70.07
26	15-Sep-21	Motijheel	12	366	51.18	12	378	41.75	23	29	25.46	49.6	86.5	63.77
27	16-Sep-21	Agargaon	41	290	92.24	30	296	52.63	19	33	22.92	60.5	96.6	71.78
28	16-Sep-21	Mirpur-10	47	240	99.74	24	131	49.53	22	102	37.88	64.6	127.5	85.17
29	17-Sep-21	Gulshan-2	9	355	37.66	7	144	22.26	11	39	15.00	49.3	120.8	62.82
30	17-Sep-21	Uttara-Abdullahpur	1	316	34.66	1	358	48.63	8	21	15.42	35.5	122.6	67.09
31	18-Sep-21	Dhanmondi-32	12	619	48.93	8	145	23.21	15	27	20.83	57	109.6	73.24
32	18-Sep-21	Shahbag	17	222	55.40	15	113	36.44	19	38	26.75	51.2	108.7	65.67
33	19-Sep-21	Tejgaon	25	727	92.35	21	407	63.53	9	23	15.21	37.7	100.5	62.58
34	19-Sep-21	Parliament Area	6	172	42.01	4	177	22.85	1	4	2.17	62.5	99.4	73.92

35	20-Sep-21	Mirpur-10	29	120	63.98	26	84	48.16	26	49	34.25	44.2	126.2	79.88
36	20-Sep-21	Agargaon	19	322	64.77	15	212	34.54	8	16	11.71	45.3	124.4	69.64
37	21-Sep-21	Gulshan-2	31	755	64.32	21	296	36.79	14	32	17.92	55.7	125.2	74.29
38	21-Sep-21	Uttara-Abdullahpur	17	276	57.26	11	160	31.70	26	36	30.88	53.7	125.5	77.14
39	22-Sep-21	Ahsan Manzil	13	958	101.12	9	420	51.55	12	36	19.46	57	120.5	72.32
40	22-Sep-21	Motijheel	9	889	114.00	6	778	81.08	12	29	16.52	61	124.5	74.49
41	23-Sep-21	Shahbag	7	798	41.32	8	177	20.45	11	39	16.12	52.7	133	67.90
42	23-Sep-21	Dhanmondi-32	19	556	60.80	14	396	37.78	12	35	17.75	54.1	125.2	72.04
43	24-Sep-21	Agargaon	24	961	61.98	23	475	46.70	15	21	16.96	44.9	125.7	65.53
44	24-Sep-21	Mirpur-10	18	157	36.62	16	68	27.50	17	40	24.82	50.9	126.9	71.85
		Average	16.73	561.16	71.01	13.27	286.07	42.22	14.91	38.86	21.34	51.92	118.67	71.74

Air Quality and Noise Level Testing (Data collection by CAPS)

Date: 1 to 25 October 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	01-Oct-2021	Parliament Area	8	541	69.32	7	567	59.79	30	39	35.00	46.2	128.5	69.92
2	01-Oct-2021	Tejgaon	26	795	124.42	14	775	81.65	27	36	32.84	51	111.3	70.37
3	02-Oct-2021	Shahbag	14	837	83.34	8	876	69.80	29	35	32.25	45.7	115.4	67.90
4	02-Oct-2021	Dhanmondi-32	11	318	52.45	9	334	46.41	23	33	28.08	49.6	115.4	64.89
5	04-Oct-2021	Agargaon	2	1052	119.98	2	954	90.55	4	11	6.00	49.1	129.1	77.30
6	04-Oct-2021	Mirpur-10	26	812	95.57	26	474	64.21	6	70	21.38	45.5	129.9	72.43
7	05-Oct-2021	Ahsan Manzil	41	594	123.79	42	619	125.10	33	120	69.13	46.8	115.1	70.07
8	05-Oct-2021	Motijheel	56	243	74.13	56	253	74.94	36	44	39.58	50.8	129.4	74.80
9	06-Oct-2021	Uttara-Abdullahpur	11	337	60.68	11	348	60.41	43	54	47.79	52.5	98.9	62.59
10	06-Oct-2021	Gulshan-2	42	623	97.81	43	619	94.10	44	66	54.08	53.5	128.8	77.15
11	07-Oct-2021	Tejgaon	46	538	112.98	47	562	113.62	29	50	35.67	52.5	117.4	64.54
12	07-Oct-2021	Parliament Area	95	694	182.54	96	721	181.60	29	49	38.96	52.6	117.3	64.96
13	08-Oct-2021	Uttara-Abdullahpur	93	421	139.70	80	436	127.79	32	49	36.25	47	107.5	71.69
14	08-Oct-2021	Gulshan-2	58	338	101.92	60	310	98.53	36	54	42.96	60.8	130	70.99
15	10-Oct-2021	Agargaon	9	731	104.86	9	191	71.65	28	36	31.38	54.7	109.2	73.45
16	10-Oct-2021	Mirpur-10	65	627	159.60	67	490	133.99	31	41	36.67	48.6	122	73.57
17	11-Oct-2021	Dhanmondi-32	54	580	131.61	55	609	122.07	41	54	47.42	46.3	98.7	66.48
18	11-Oct-2021	Shahbag	58	160	74.39	63	123	77.68	39	52	44.22	50.4	123.1	66.33
19	12-Oct-2021	Motijheel	6	204	32.22	6	95	29.94	19	49	22.76	38.1	119.3	67.80
20	12-Oct-2021	Ahsan Manzil	13	150	46.90	14	154	47.01	30	46	36.04	53	127.9	71.01
21	13-Oct-2021	Parliament Area	50	211	72.55	50	85	66.95	14	31	19.54	48.2	100.1	65.20
22	13-Oct-2021	Tejgaon	9	118	31.17	9	119	23.38	14	29	22.13	51.4	98	64.05
23	14-Oct-2021	Dhanmondi-32	32	117	64.81	31	93	52.44	14	26	20.88	43	107.9	74.79
24	14-Oct-2021	Shahbag	25	101	79.36	26	98	75.36	16	42	22.84	47.3	104.5	67.22
25	15-Oct-2021	Ahsan Manzil	18	456	47.40	18	155	33.77	9	25	19.04	46	110.1	68.06
26	15-Oct-2021	Motijheel	21	311	48.29	22	325	41.13	14	28	20.63	48.1	95.3	64.34
27	17-Oct-2021	Gulshan-2	9	569	52.95	8	593	34.03	13	22	17.96	49	109.3	70.44
28	17-Oct-2021	Uttara-Abdullahpur	14	242	60.12	10	229	37.49	19	27	21.96	48.2	130.6	73.69
29	18-Oct-2021	Mirpur-10	6	108	30.43	4	87	20.95	5	17	8.75	54	106.1	73.96
30	18-Oct-2021	Agargaon	7	187	34.86	6	196	30.15	11	30	17.58	55	119	77.81
31	19-Oct-2021	Parliament Area	1	244	16.18	1	250	11.27	9	36	10.11	42.1	111.2	66.73
32	19-Oct-2021	Tejgaon	6	286	34.02	5	301	32.74	18	35	25.29	52.7	97.5	64.26
33	20-Oct-2021	Gulshan-2	1	124	34.30	1	127	31.97	8	39	21.08	41.3	122.8	63.49
34	20-Oct-2021	Uttara-Abdullahpur	2	129	48.86	3	110	42.55	15	39	24.88	54.7	97	62.91

35	21-Oct-2021	Mirpur-10	38	346	77.92	40	360	75.72	11	28	20.71	48.2	97.5	63.87
36	21-Oct-2021	Agargaon	42	274	68.03	43	95	52.36	10	30	20.75	46.8	110.4	69.22
37	22-Oct-2021	Dhanmondi-32	54	154	69.24	56	101	67.05	13	34	23.96	42.8	119.2	59.40
38	22-Oct-2021	Shahbag	79	150	95.20	81	118	94.21	7	28	17.08	45	127.7	63.73
39	23-Oct-2021	Motijheel	56	139	81.61	53	110	65.27	3	36	21.08	61.8	99.4	74.08
40	23-Oct-2021	Ahsan Manzil	54	180	64.77	55	82	61.88	6	33	19.04	50.5	125.9	65.99
41	24-Oct-2021	Parliament Area	59	151	70.51	57	83	62.40	6	37	21.04	53.7	125.5	75.88
42	24-Oct-2021	Tejgaon	42	120	75.49	26	96	71.80	6	39	19.17	57.6	99.4	69.67
43	25-Oct-2021	Gulshan-2	48	187	77.76	50	131	78.42	3	44	23.67	53.7	125.5	77.49
44	25-Oct-2021	Uttara-Abdullahpur	42	115	60.23	42	117	48.60	8	41	26.67	57.9	124.7	80.43
		Average	32.93	354.86	76.92	32.09	308.43	67.79	19.11	40.09	27.82	49.86	114.52	69.43

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 2 to 26 November 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	02-Nov-2021	Parliament Area	3	875	70.78	3	235	47.83	28	38	32.08	49.3	126.5	76.17
2	02-Nov-2021	Tejgaon	3	114	36.67	3	111	35.94	15	53	25.16	60.2	110.5	70.93
3	03-Nov-2021	Gulshan-2	15	580	44.14	16	164	37.83	8	56	32.50	44.2	109.3	69.12
4	03-Nov-2021	Uttara-Abdullahpur	15	1434	152.16	16	436	81.36	51	73	58.04	49.1	125.9	69.18
5	05-Nov-2021	Dhanmondi-32	48	269	85.93	47	275	61.66	23	46	34.67	36.6	91.1	58.97
6	05-Nov-2021	Shahbag	6	638	62.80	4	190	44.50	20	38	29.17	45.4	108.9	64.55
7	06-Nov-2021	Motijheel	4	270	58.05	4	214	37.62	7	28	16.38	46.6	109.1	69.91
8	06-Nov-2021	Ahsan Manzil	1	230	30.77	1	136	22.56	20	38	21.00	41	125.5	60.80
9	07-Nov-2021	Mirpur-10	11	820	40.46	11	222	25.28	19	34	21.30	45.4	109.1	69.85
10	07-Nov-2021	Agargaon	2	1120	160.27	1	897	84.22	16	29	22.50	58.7	117.4	74.22
11	08-Nov-2021	Motijheel	21	207	42.68	20	208	36.90	26	53	30.17	52.2	98.9	62.11
12	08-Nov-2021	Ahsan Manzil	3	252	29.42	3	83	25.52	16	65	20.21	52.6	117.3	64.92
13	09-Nov-2021	Mirpur-10	6	652	102.34	3	357	66.95	58	71	63.00	50.5	120.9	66.37
14	09-Nov-2021	Agargaon	72	2179	256.65	60	650	110.60	59	676	93.33	55.8	123	79.67
15	10-Nov-2021	Shahbag	4	468	43.15	4	252	34.83	20	89	25.76	49	109.9	70.03
16	10-Nov-2021	Dhanmondi-32	1	670	80.03	1	270	48.51	28	83	30.15	45.3	123	66.25
17	11-Nov-2021	Gulshan-2	21	824	95.23	15	385	68.06	43	92	57.32	45.3	130	63.32
18	11-Nov-2021	Uttara-Abdullahpur	7	905	125.60	5	395	93.97	68	81	75.83	45	110.8	65.41
19	12-Nov-2021	Parliament Area	1	406	52.88	1	227	37.08	21	88	30.36	45.6	128	70.21
20	12-Nov-2021	Tejgaon	19	750	302.71	19	786	286.68	7	99	78.00	45.3	96	58.28
21	13-Nov-2021	Agargaon	31	347	121.49	32	277	101.70	82	103	91.63	36.8	108.5	70.31
22	13-Nov-2021	Mirpur-10	4	347	143.55	4	227	122.92	97	139	114.29	44.7	118.9	64.77
23	14-Nov-2021	Tejgaon	6	253	80.33	6	263	71.78	60	95	61.80	44.6	105.7	63.56
24	14-Nov-2021	Parliament Area	1	380	42.23	1	181	38.62	18	109	35.54	44.9	105.5	68.72
25	15-Nov-2021	Uttara-Abdullahpur	1	832	55.25	1	349	49.54	36	187	44.96	59.3	123	80.22
26	15-Nov-2021	Gulshan-2	1	212	72.92	2	193	66.60	20	125	56.50	45	127.7	63.87
27	16-Nov-2021	Dhanmondi-32	1	289	37.22	1.0	171	32.04	22	133	25.63	42.8	102.9	62.54
28	16-Nov-2021	Shahbag	6	364	104.63	6	379	90.80	48	111	86.92	45.3	126.3	72.79
29	19-Nov-2021	Mirpur-10	11	460	86.92	7	343	32.37	22	135	28.08	44.4	120.5	69.16
30	19-Nov-2021	Agargaon	1	328	43.09	1	314	33.72	24	108	29.83	61	124.5	73.68
31	20-Nov-2021	Gulshan-2	1	420	44.85	1	240	34.22	18	95	28.38	47.3	119.2	67.21
32	20-Nov-2021	Uttara-Abdullahpur	8	775	88.65	8	222	73.65	64	88	67.29	46.2	126.8	65.29
33	21-Nov-2021	Motijheel	8	623	105.20	9	292	95.99	58	77	64.75	46.1	113.3	73.64
34	21-Nov-2021	Ahsan Manzil	18	570	122.99	19	598	107.63	56	70	62.38	44	123.6	69.61

35	22-Nov-2021	Tejgaon	16	521	95.36	17	427	79.05	67	133	75.92	45.2	103.2	64.28
36	22-Nov-2021	Parliament Area	7	454	101.37	7	292	83.90	55	116	69.92	44.9	124.5	70.06
37	23-Nov-2021	Ahsan Manzil	39	555	165.88	36	481	146.67	44	91	51.52	47.1	125.8	72.03
38	23-Nov-2021	Motijheel	94	377	184.82	98	275	184.59	41	47	44.55	41.4	128.5	77.39
39	24-Nov-2021	Tejgaon	96	389	217.75	95.0	331	183.04	40	45	42.13	45	128.2	72.94
40	24-Nov-2021	Parliament Area	1	378	100.14	2	313	89.44	40	45	42.17	60.8	110.5	70.99
41	25-Nov-2021	Ahsan Manzil	6	355	66.06	7	201	56.30	30	79	46.43	43.6	110.2	68.96
42	25-Nov-2021	Motijheel	69	359	126.77	70	164	100.22	28	117	52.29	44.6	120.8	59.15
43	26-Nov-2021	Dhanmondi-32	98	311	147.03	99	168	141.10	37	44	39.71	46	128.2	76.18
44	26-Nov-2021	Shahbag	12	777	256.61	13	261	140.04	33	38	34.92	41.7	130.2	72.15
		Average	18.16	553.16	101.90	17.70	305.80	78.27	36.20	94.55	47.60	47.18	116.99	68.63

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 3 to 26 December 2021

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	03-Dec-2021	Uttara-Abdullahpur	3	114	36.70	3	111	35.92	14	18	15.08	52.2	101.7	68.81
2	03-Dec-2021	Gulshan-2	2	714	40.96	2	130	29.32	21	56	26.54	52.6	117.3	65.00
3	04-Dec-2021	Tejgaon	11	887	167.31	11.0	895	162.25	18	22	20.13	43.8	96.3	62.91
4	04-Dec-2021	Parliament Area	1	655	24.54	2	190	17.89	14	21	15.38	45.8	96.8	55.11
5	06-Dec-2021	Dhanmondi-32	1	417	56.67	1	435	57.82	18	21	18.88	54.4	89.7	63.31
6	06-Dec-2021	Shahbag	1	155	14.72	1	161	14.40	10	25	12.75	60.1	125.5	78.39
7	07-Dec-2021	Motijheel	1	438	47.85	1	444	45.05	20	38	26.38	44.6	115.1	71.35
8	07-Dec-2021	Ahsan Manzil	1	25	3.00	1	26	2.70	1	27	2.08	53.2	98.9	63.84
9	8-Dec-21	Mirpur-10	26	421	75.17	18	167	40.87	9	36	20.12	56.4	103.8	70.36
10	8-Dec-21	Agargaon	14	713	137.49	14	153	39.60	6	24	16.29	58.2	125.6	74.49
11	9-Dec-21	Gulshan-2	44	179	105.04	35	141	79.23	20	45	35.25	47.4	98.9	64.59
12	9-Dec-21	Uttara-Abdullahpur	0	785	47.38	0	160	24.26	2	27	22.42	44.9	128.2	71.48
13	10-Dec-21	Dhanmondi-32	18	300	43.90	17	125	29.81	12	16	13.79	48.9	127.5	75.39
14	10-Dec-21	Shahbag	13	101	27.19	12	95	25.85	8	31	14.42	57.9	94.4	71.60
15	11-Dec-21	Parliament Area	14	56	26.70	15	55	23.98	7	10	8.83	53.4	98.3	67.54
16	11-Dec-21	Tejgaon	14	785	27.75	14	136	20.02	14	32	16.89	44	128.3	66.53
17	13-Dec-21	Ahsan Manzil	14	837	83.34	8	876	69.80	29	35	32.25	45.7	115.4	67.90
18	13-Dec-21	Motijheel	26	812	95.57	26	474	64.21	6	70	21.38	45.5	129.9	72.43
19	14-Dec-2021	Parliament Area	2	591	185.96	2	582	155.15	87	106	97.71	43.8	96.9	59.48
20	14-Dec-2021	Tejgaon	1	865	150.26	1	895	147.39	98	116	106.54	43.8	95.8	52.03
21	15-Dec-2021	Ahsan Manzil	1	483	82.67	1.0	369	68.79	49	119	59.25	37.3	95.7	63.61
22	15-Dec-2021	Motijheel	2	422	111.92	2	410	88.11	78	114	84.71	48.8	127.8	74.18
23	16-Dec-2021	Uttara-Abdullahpur	1	1069	65.33	1	349	50.39	40	104	46.71	44.9	128.2	74.01
24	16-Dec-2021	Gulshan-2	12	377	68.80	12	310	63.57	49	102	54.79	44.4	69.1	49.44
25	17-Dec-2021	Agargaon	3	561	45.45	3	343	36.70	15	189	29.88	45.2	125.7	72.38
26	17-Dec-2021	Mirpur-10	1	537	32.38	1	147	20.62	15	209	17.88	42.1	121.6	63.09
27	18-Dec-2021	Dhanmondi-32	20	264	81.89	21.0	274	79.03	45	164	66.04	47.3	104.5	67.22
28	18-Dec-2021	Shahbag	1	486	51.61	2	284	42.69	31	183	36.88	57	127.4	78.04
29	19-Dec-2021	Parliament Area	4	184	32.33	5	103	24.15	16	155	19.72	52.3	123.9	67.41
30	19-Dec-2021	Tejgaon	12	463	82.34	12	394	72.02	57	83	70.21	61	124.5	74.48
31	20-Dec-2021	Mirpur-10	2	571	85.21	3	481	62.60	46	155	57.96	61	124.5	74.46
32	20-Dec-2021	Agargaon	2	682	91.32	2	701	83.99	67	72	69.33	47.3	104.5	66.77
33	21-Dec-2021	Shahbag	194	1195	418.21	175	957	299.26	47	59	51.08	42.1	95.7	62.93
34	21-Dec-2021	Dhanmondi-32	55	371	199.59	57	314	187.11	47	66	52.68	44.9	128.2	73.87

35	22-Dec-2021	Uttara-Abdullahpur	98.0	624	239.28	101.0	527	243.29	44.0	54	48.79	56.6	127.9	69.97
36	22-Dec-2021	Gulshan-2	126	778	326.54	129	689	318.75	50	69	53.48	45.5	129.9	72.63
37	23-Dec-2021	Ahsan Manzil	68	460	185.10	71	437	149.17	43	50	45.21	44.7	120.5	72.88
38	23-Dec-2021	Motijheel	68	417	223.09	53	416	197.95	41	45	43.38	61	126.4	76.09
39	24-Dec-2021	Tejgaon	27	241	142.52	5	147	111.60	42	47	44.12	39.2	101.7	63.12
40	24-Dec-2021	Parliament Area	112	418	244.70	115	331	244.02	41	45	43.25	45.5	129.9	74.63
41	25-Dec-2021	Agargaon	44.0	285	168.69	45.0	166	134.32	110.0	122	116.67	59.9	113.9	73.38
42	25-Dec-2021	Mirpur-10	138	810	262.47	91	429	215.20	110	163	140.92	44.5	129.9	72.86
43	26-Dec-2021	Dhanmondi-32	116	346	199.88	102	212	146.45	95	116	105.68	55.7	100.4	71.04
44	26-Dec-2021	Shahbag	89	1013	551.20	92	912	405.01	164	197	177.72	47	107.5	73.44
		Average	31.89	520.61	122.50	29.20	362.57	100.69	39.91	78.59	47.26	49.36	113.04	68.74

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 4 to 29 January 2022

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	04-Jan-2022	Shahbag	251	1165	456.25	185	668	272.38	115	188	161.75	35.7	130.6	76.13
2	04-Jan-2022	Dhanmondi-32	7	649	145.45	7	279	111.38	137	261	90.70	51.8	90	63.25
3	05-Jan-2022	Parliament Area	61	737	211.96	63	332	184.26	206	342	150.60	42.5	127.2	69.10
4	05-Jan-2022	Tejgaon	5	340	33.74	5	276	30.78	177	227	25.20	44.1	95.3	54.13
5	06-Jan-2022	Uttara-Abdullahpur	4.0	585	43.41	4.0	224	37.77	153.0	191	33.50	44.6	126.7	65.26
6	06-Jan-2022	Gulshan-2	1	1453	111.71	1	1459	85.26	141	185	70.57	44.3	98.6	64.53
7	07-Jan-2022	Agargaon	10	652	78.73	11	665	76.19	58	74	64.50	36.6	87.1	58.13
8	07-Jan-2022	Mirpur-10	40	508	139.88	41	224	126.19	78	214	120.12	45	127.7	63.25
9	09-Jan-2022	Ahsan Manzil	1	1158	82.95	1	285	47.66	63	415	35.23	55.7	125.2	73.21
10	09-Jan-2022	Motijheel	2	274	41.29	2	170	36.15	60	78	28.80	52.7	112.8	70.64
11	10-Jan-2022	Mirpur-10	37.0	1234	343.39	38.0	508	214.36	177.0	260	180.47	43.4	107.6	65.74
12	10-Jan-2022	Agargaon	18.0	738	174.36	18	217	131.57	99.0	346	101.23	40.4	113.2	68.03
13	12-Jan-2022	Abdullahpur	1	494	167.05	1	226	153.54	102	123	115.17	42.9	106.4	71.15
14	12-Jan-2022	Gulshan-2	88	404	227.08	91	314	206.39	103	126	114.63	50.1	115.1	72.80
15	13-Jan-2022	Motijheel	98	682	284.85	93	648	276.37	91	118	101.46	44.9	101.4	70.34
16	13-Jan-2022	Ahsan Manzil	16	624	183.60	11	426	166.90	88	122	105.13	59.2	128.8	77.85
17	14-Jan-2022	Tejgaon	88	778	231.88	84	689	226.46	103	144	122.71	44.3	90.8	54.17
18	14-Jan-2022	Parliament Area	37	571	187.14	34	481	137.99	60	90	72.08	54.9	126.4	76.11
19	15-Jan-2022	Gulshan-2	15	1195	260.14	12	957	194.50	231	360	150.47	50.7	115.1	72.86
20	15-Jan-2022	Abdullahpur	15	1195	300.70	12	957	215.87	214	273	180.78	39.3	99.5	64.10
21	16-Jan-2022	Agargaon	15	1195	312.66	12	957	228.73	259	332	140.34	42.3	95.2	58.68
22	16-Jan-2022	Mirpur-10	58	427	226.14	37	275	198.65	225	292	140.98	57	125.7	77.61
23	18-Jan-2022	Ahsan Manzil	8	1041	138.34	8	1075	105.43	191	336	80.59	45.5	127.6	67.85
24	18-Jan-2022	Motijheel	40	748	239.39	42	353	160.14	217	350	123.87	49.3	126.9	70.16
25	19-Jan-2022	Shahbag	40	748	262.21	42	353	176.60	184	237	132.62	53.2	128.1	72.02
26	19-Jan-2022	Dhanmondi-32	86	1041	237.59	88	1075	183.37	181	226	151.43	54.6	107.2	71.30
27	20-Jan-2022	Abdullahpur	40	1041	200.30	42	1075	142.28	128	413	120.47	53.6	118.8	67.84
28	20-Jan-2022	Gulshan-2	40	748	246.77	42	353	163.23	133	174	156.04	53	126.9	69.95
29	21-Jan-2022	Mirpur-10	11	1041	220.79	12	1075	144.54	133	174	110.32	59	127.4	78.25
30	21-Jan-2022	Agargaon	40	748	243.44	42	353	159.34	129	174	153.38	49.3	129.3	75.94
31	22-Jan-2022	Tejgaon	50	1041	259.80	51	1075	185.30	131	173	154.00	46.1	118.2	69.48
32	22-Jan-2022	Parliament Area	40	1041	246.27	42	1075	172.70	135	182	162.25	49.3	127.5	76.20
33	23-Jan-2022	Dhanmondi-32	40	1041	173.64	42	1075	136.69	126	281	120.10	60.8	110.5	70.93
34	23-Jan-2022	Shahbag	20	1338	346.73	21	444	226.35	148	184	162.04	44.8	129.1	68.84

35	24-Jan-2022	Motijheel	40	1041	194.85	42	1075	141.72	167	319	98.59	56.7	99	74.92
36	24-Jan-2022	Ahsan Manzil	40	748	201.86	42	321	139.27	154	307	109.28	46.2	105.3	66.19
37	25-Jan-2022	Agargaon	11	1041	167.34	12	1075	134.73	117	158	102.35	61.1	125.6	77.57
38	25-Jan-2022	Mirpur-10	86	1041	185.32	88	1075	155.24	135	158	146.92	44.8	128.2	67.26
39	27-Jan-2022	Shahbag	62	1041	205.46	59	1075	161.83	132	154	142.04	58.5	115.2	72.93
40	27-Jan-2022	Dhanmondi-32	62	1041	198.56	59	1075	157.45	129	162	145.71	45	128.2	70.75
41	28-Jan-2022	Parliament Area	62	1041	197.27	59	1075	156.04	139	260	134.39	55.5	99	74.14
42	28-Jan-2022	Tejgaon	62	1341	198.67	59	1075	156.54	145	196	121.32	55.6	129.4	79.79
43	29-Jan-2022	Ahsan Manzil	62	1041	206.69	59	1075	163.72	143	186	141.70	56.7	121.9	74.80
44	29-Jan-2022	Motijheel	62	1041	208.31	59	1075	166.65	151	195	137.36	47	107.5	71.70
		Average	42.55	888.45	205.09	40.34	695.77	155.65	140.64	221.82	118.48	49.27	115.53	69.91

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 1 to 25 February 2022

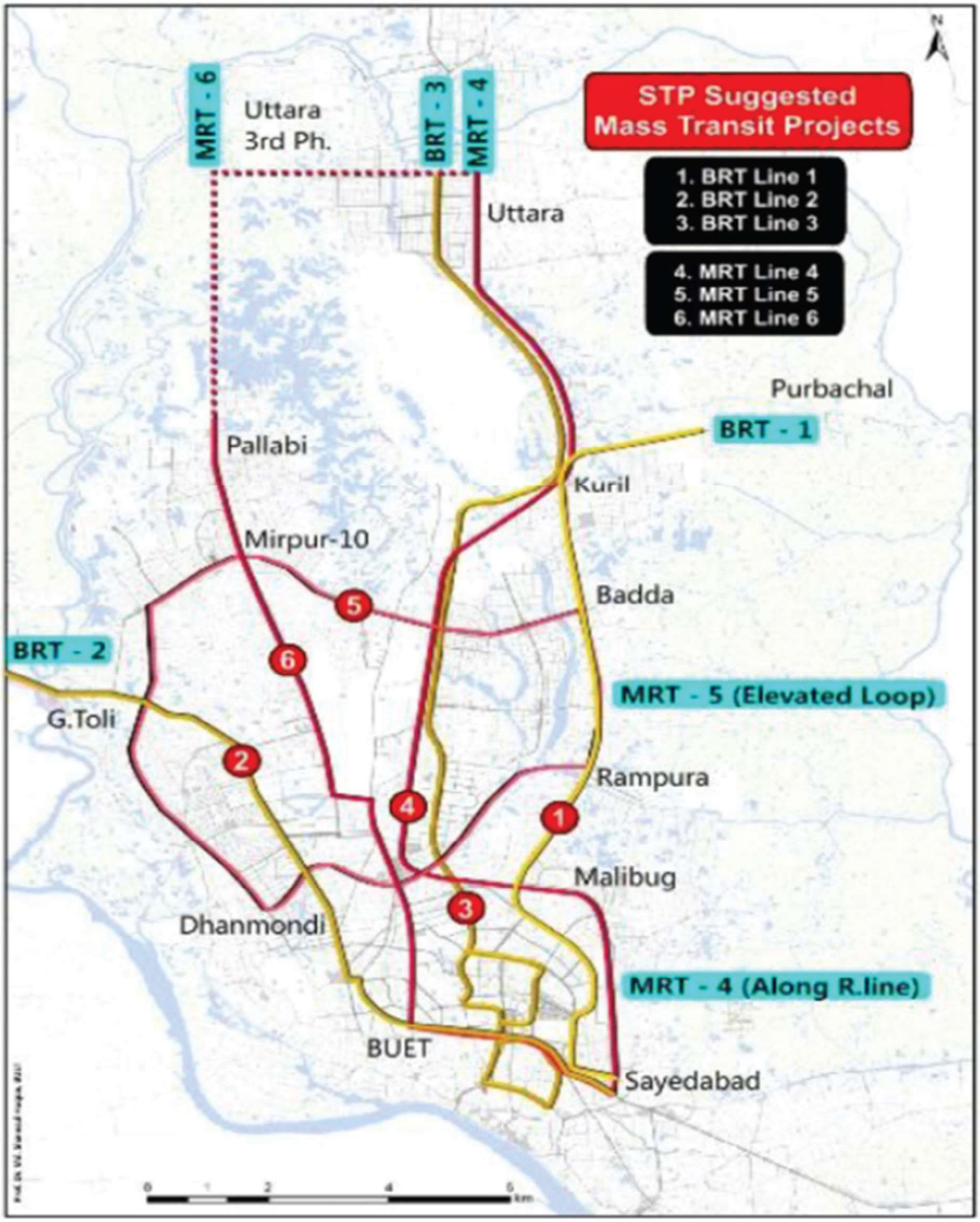
SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	01-Feb-2022	Abdullahpur	48	174	122.95	49	173	106.08	39	142	101.12	44.6	98.7	62.69
2	01-Feb-2022	Gulshan-2	33	584	146.90	32	418	115.76	37	137	111.30	49	124.3	73.43
3	02-Feb-2022	Dhanmondi-32	85	1041	219.83	88	1075	189.66	32	198	170.29	43	111.1	65.13
4	02-Feb-2022	Shahbag	59	1041	203.48	44	1075	173.55	55	186	168.88	55	119	76.60
5	04-Feb-2022	Tejgaon	11.0	1158	139.91	9.0	285	76.48	12.0	55	26.96	64.2	82.9	72.91
6	04-Feb-2022	Parliament Area	34	234	57.25	31	240	43.52	35	164	30.32	44	124.5	64.23
7	07-Feb-2022	Agargaon	27	1158	193.55	29	285	108.04	39	320	66.00	60.8	93.5	71.10
8	07-Feb-2022	Mirpur-10	12	654	146.29	9	424	113.41	44	177	56.33	43.6	110.2	68.96
9	08-Feb-2022	Ahsan Manzil	8	623	105.20	9	292	95.99	36	182	60.54	43.8	114.8	60.48
10	08-Feb-2022	Motijheel	13	623	162.28	14	598	137.68	58	184	43.96	42.8	118.7	66.29
11	09-Feb-2022	Shahbag	103.0	896	258.20	106.0	388	176.34	73.0	226	98.83	59.2	126.1	79.61
12	09-Feb-2022	Dhanmondi-32	24.0	410	156.71	25	224	120.08	71.0	208	87.04	43.5	123.8	68.17
13	10-Feb-2022	Motijheel	64	639	444.35	65	593	400.69	94	231	210.00	53.2	123.3	75.52
14	10-Feb-2022	Ahsan Manzil	50	519	290.12	52	497	278.12	75	114	90.29	43.1	123.8	68.94
15	11-Feb-2022	Abdullahpur	18	943	115.63	19	687	105.59	36	178	59.25	43.8	118.6	61.00
16	11-Feb-2022	Gulshan-2	54	606	216.79	56	361	199.18	31	262	158.17	43.5	103.3	66.94
17	12-Feb-2022	Mirpur-10	66	577	131.98	48	408	125.64	37	202	63.00	57.3	125.6	77.02
18	12-Feb-2022	Agargaon	44	570	215.53	37	598	181.53	87	284	30.92	48.7	115.1	70.92
19	14-Feb-2022	Gulshan-2	62	1041	198.56	59	1075	157.45	39	200	69.04	56.1	125.6	72.04
20	14-Feb-2022	Abdullahpur	62	1041	213.91	59	1075	172.37	51	385	98.46	48.9	115.1	7.24
21	15-Feb-2022	Tejgaon	11	246	105.56	12	235	86.98	68	548	31.83	56.4	93.8	67.68
22	15-Feb-2022	Parliament Area	9	600	93.19	9	254	62.10	46	327	60.33	44.6	109.3	65.52
23	16-Feb-2022	Shahbag	25	562	200.00	26	254	105.24	42	301	17.08	60.6	127.6	82.63
24	16-Feb-2022	Dhanmondi-32	11	392	129.46	8	349	104.10	20	439	49.72	44.9	124.3	68.30
25	17-Feb-2022	Parliament Area	73	542	153.82	74	227	147.87	69	298	11.16	46.8	107.3	70.64
26	17-Feb-2022	Tejgaon	72	493	267.07	74	509	215.50	94	224	206.88	44.7	105.6	65.66
27	18-Feb-2022	Agargaon	13	1041	188.15	14	1075	168.57	89	241	15.29	44.9	99.9	57.76
28	18-Feb-2022	Mirpur-10	14	534	163.08	15	220	109.69	20	231	14.42	50.9	126.4	74.87
29	19-Feb-2022	Motijheel	33	480	126.35	34	283	75.01	85	517	43.79	45.2	103.6	67.32
30	19-Feb-2022	Ahsan Manzil	11	480	124.08	7	283	75.06	48	177	63.09	46.1	99	71.29
31	20-Feb-2022	Mirpur-10	20	485	138.42	20	236	74.67	81	332	22.50	43.9	114.7	72.95
32	20-Feb-2022	Agargaon	12	329	72.73	11	341	70.55	3	91	19.00	44.8	96.1	59.00
33	21-Feb-2022	Abdullahpur	42	471	192.55	32	119	67.06	81	95	60.67	45.6	119.4	72.82
34	21-Feb-2022	Gulshan-2	23	412	127.59	23	93	57.99	75	109	40.43	44.3	106.4	62.82

35	22-Feb-2022	Ahsan Manzil	68	302	149.89	71	308	151.54	88	140	102.92	43.6	88.4	55.79
36	22-Feb-2022	Motijheel	12	418	53.51	13	446	41.71	30	180	34.08	54.9	127.4	76.37
37	23-Feb-2022	Dhanmondi-32	79	255	155.38	81	260	146.64	78	142	105.83	45.3	106.4	65.36
38	23-Feb-2022	Shahbag	28	563	200.14	29	329	117.88	85	152	110.38	44	125.6	75.34
39	24-Feb-2022	Abdullahpur	10	991	155.27	10	550	91.09	72	132	78.71	48.1	121.7	74.26
40	24-Feb-2022	Gulshan-2	11	408	94.56	11	404	84.31	10	169	78.67	45	122.7	69.51
41	25-Feb-2022	Ahsan Manzil	41	696	128.61	39	472	76.85	85	142	60.67	45.6	117.3	66.13
42	25-Feb-2022	Motijheel	61	395	142.25	45	257	84.84	48	517	63.09	45.2	100.2	68.92
		Average	37.05	610.17	164.31	35.67	435.12	126.01	54.71	227.12	73.60	48.18	112.88	67.62

Air Quality and Noise Level Testing (Data collection by CAPS)
Date: 07 to 30 March 2022

SN	Date	Location	PM_{10}			$PM_{2.5}$			PM_1			Noise		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1	07-Mar-2022	Parliament Area	3	1137	87.33	3	1108	65.58	21	176	23.38	44.4	123.8	68.10
2	07-Mar-2022	Tejgaon	14	357	90.39	14	371	76.99	57	97	71.38	45.9	106.7	70.99
3	08-Mar-2022	Abdullahpur	14	399	93.92	14	149	81.18	26	65	40.83	46.2	131.1	70.16
4	08-Mar-2022	Gulshan-2	13	569	140.77	13	594	128.80	47	59	52.21	48.6	100.3	68.39
5	09-Mar-2022	Shahbag	20.0	2319	129.93	21.0	1545	96.56	78.0	167	86.00	44.1	124.7	65.33
6	09-Mar-2022	Dhanmondi-32	5	1043	157.06	5	986	123.15	93	164	118.13	44	125.8	64.56
7	10-Mar-2022	Mirpur-10	8	937	130.73	8	641	107.60	126	152	102.43	45.3	130	70.80
8	10-Mar-2022	Agargaon	2	281	47.61	2	197	30.97	8	131	19.50	57.4	130.2	74.56
9	11-Mar-2022	Motijheel	28	328	90.86	29	308	75.85	38	167	65.96	48.3	128.3	68.21
10	11-Mar-2022	Ahsan Manzil	2	528	73.45	3	549	64.45	19	164	58.13	49	112.9	67.44
11	13-Mar-2022	Agargaon	35.0	1866	100.69	35.0	423	63.78	34.0	113	58.75	45.4	119	65.78
12	13-Mar-2022	Mirpur-10	11.0	241	98.67	11	193	60.96	24.0	113	48.79	45.5	130.1	74.14
13	14-Mar-2022	Gulshan-2	34	606	66.71	35	196	63.32	32	190	56.79	45.8	127.8	62.31
14	14-Mar-2022	Abdullahpur	36	1028	145.00	28	388	102.02	59	88	76.13	45.7	128.5	66.34
15	17-Mar-2022	Parliament Area	9	171	30.89	9	134	26.17	5	95	17.00	45.7	96.7	58.95
16	17-Mar-2022	Tejgaon	1	379	38.04	1	197	29.51	6	143	26.46	45.3	101.8	65.74
17	18-Mar-2022	Shahbag	2	366	39.54	2	110	23.92	4	162	17.04	48.1	100.3	67.69
18	18-Mar-2022	Dhanmondi-32	7	395	42.35	7	132	36.40	6	243	21.54	60.2	126.7	77.67
19	20-Mar-2022	Motijheel	7	395	48.72	7	132	36.37	23	140	25.67	53.4	127.6	67.91
20	20-Mar-2022	Ahsan Manzil	9	340	68.85	10	355	56.80	20	68	25.42	45.7	128	67.70
21	21-Mar-2022	Gulshan-2	4	227	32.75	4	177	32.72	18	34	25.13	45.8	100.5	59.65
22	21-Mar-2022	Abdullahpur	78	1108	266.63	51	349	102.45	18	232	24.92	57.4	117.7	68.30
23	22-Mar-2022	Mirpur-10	8	1116	73.68	9	279	47.92	13	24	17.88	48.5	100.1	70.94
24	22-Mar-2022	Agargaon	14	446	81.01	15	185	58.95	18	57	38.21	46.7	123.1	69.97
25	23-Mar-2022	Gulshan-2	8	453	82.89	8	328	63.18	39	53	45.50	46.1	127.2	66.77
26	23-Mar-2022	Abdullahpur	2	827	63.43	2	257	40.98	18	32	24.92	45.7	127.1	63.13
27	25-Mar-2022	Shahbag	24	230	60.56	25	243	52.28	30	38	34.46	53.8	126.5	70.37
28	25-Mar-2022	Dhanmondi-32	2	207	33.48	2	77	28.33	15	40	24.17	48.2	128.5	78.61
29	26-Mar-2022	Ahsan Manzil	21	259	54.16	20	158	46.13	29	42	36.42	52.2	96.9	63.23
30	26-Mar-2022	Motijheel	27	473	77.39	28	166	67.42	32	39	36.21	46	128.2	73.37
31	27-Mar-2022	Abdullahpur	31	1742	177.13	32	1187	99.50	31	66	41.42	54.6	118.8	77.28
32	27-Mar-2022	Gulshan-2	11	388	91.37	12	129	71.58	7	17	11.63	44.6	105.2	65.52
33	28-Mar-2022	Agargaon	57	521	144.17	53	155	80.69	8	13	10.04	64.5	94.6	75.78
34	28-Mar-2022	Mirpur-10	52	442	111.53	52	212	76.83	17	32	22.25	34.4	123.5	58.86
35	29-Mar-2022	Shahbag	10	291	56.00	10	210	52.45	17	37	23.50	45.5	128.7	65.12
36	29-Mar-2022	Dhanmondi-32	27	408	60.79	28	189	54.67	17	37	26.83	51.6	128.5	80.53
37	30-Mar-2022	Ahsan Manzil	19	203	47.43	20	213	42.20	8	93	17.17	49.3	125.9	63.54
38	30-Mar-2022	Motijheel	9	707	92.55	8	201	61.79	9	18	12.13	52.2	127.7	73.48
		Average	17.47	624.55	87.59	16.74	353.24	63.96	28.16	94.76	39.06	48.45	119.18	68.61

Annex – C: Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) Project Line



Source: Hoque et al. (2012)