World Vision

Community Based Approaches to Addressing Urban Air Pollution

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2. Executive Summary

The urban areas of Bangladesh, particularly Dhaka, have witnessed a rapid increase in air pollution, particularly in dry seasons. Over the last three years, Dhaka has been repeatedly dubbed the most polluted city (AQI-US) globally and has consistently remained among the top 5 with emissions from brick kilns, rapid construction, and an increase in vehicle usage among the key contributors. Exposure to air pollution has adverse health effects, with varying degrees of respiratory complications, e.g., asthma, lung inflammation, and cancer. While air pollution negatively affects Bangladesh's population in general, this impact is more prominent among the more vulnerable segments, i.e., pregnant women and children. Pregnant women exposed to common air pollutants are more likely to give birth prematurely and have small, low birth-weight children. Air pollution also impacts neurodevelopment and cognitive ability and can stunt lung growth, and cause childhood cancer. Consequent to the health impact, air pollution also affects the Bangladesh economy. Health complications for adults result in increased sick days, reduction in productivity, and for children result in time away from school and absence of participation in critical cognitive development activities, which have both short and long-term adverse effects on the national economy. Furthermore, as a result of rapid economic growth in urban areas, particularly Dhaka city, there is at present an increase in rural to urban migration which is expected to increase even further in the future. The prospect of an increasing population concentration supplemented by government plans to undertake the construction of more mega infrastructure projects may result in further deterioration of the air quality in urban areas. Consequently, interventions are required to help ensure that the growth and development are sustainable in the long haul. Hence this study aims to provide a comprehensive set of intervention options for World Vision Bangladesh to facilitate the mitigation of air pollution by ensuring engagement at the youth and community level.

The design of the study followed three initial building blocks(three-block aggregation framework)- the innovation competition, global benchmarking, and local context analysis to aggregate a primary pool of intervention ideas to address urban air pollution. The *innovation competition* was formulated to address the current nationwide gap in youth-led innovative solutions that addressed air pollution. The participants for the innovation competition primarily constituted college/university students, young professionals, and young adults currently enrolled in high school level education from around the country, notably from the most susceptible urban, peri-urban areas. By providing a platform for these youth to directly present and develop their ideas into theoretically workable solutions over the duration of the competition via thorough assessment and mentoring, the innovation competition played a crucial role in ensuring that the initial pool of ideas was solely youth generated and "best fit" as per the perceived local context. During the *global benchmarking* phase, the assessment team identified and formulated interventions based on two major cohorts- mapping of global best practices and documenting global interventions that address air pollution. Mapping global best practices involved identifying international policies and guidelines regarding various emission-generating economic activities that ensure minimal environmental impact. These include global construction, industrial, and vehicular emission policies and guidelines from global economies as well as identification of traditional process alternatives. Documenting global interventions primarily constituted the identification of proven interventions addressing air pollution that were

both youth-led and community-driven or standalone. Interventions derived from the global benchmarking block were then contrasted with the local context analysis to assess local intervention and policy gaps. The *local context analysis also* comprised two cohorts- identifying current local interventions and air pollution-related youth perception mapping. Documentation of local interventions, particularly those that are youth-driven, helped provide the assessment team with insights based on what is currently being undertaken at a youth level and assess potential nationwide scalability. Youth perception mapping via focused group discussions, Key Informant Interviews, and desk review of existing literature of prevailing youth perception in the Bangladeshi context also played a critical role in formulating interventions by assessing current youth-level knowledge gaps and desire to be part of youth-led, community-driven initiatives.

Following the pooling of primary intervention ideas using the three blocked aggregation framework, the assessment team proceeded to the second tier of the study where the pooled ideas underwent a critical filtration process to ensure feasibility and ease of implementation in the Bangladeshi context. During this *assessment and validation* stage, the study team consulted ecosystem actors and experts who evaluated the pool of intervention ideas. This stage had three broad outcomes: 1. Ideas not relevant in the Bangladeshi context were discarded 2. Ideas with potential but in a nascent stage were identified 3. Ideas with potential and relevance in the Bangladeshi context were identified and molded to ensure youth and community engagement. During this stage, the intervention ideas underwent five stages of validation where Idea Feasibility, Innovation Feasibility, Inclusion Potential, Initial Investment & Financial Feasibility, and Feasibility in the Bangladesh Context were assessed. The assessment and validation stage supplemented with the *findings* of the study resulted in a pool of refined intervention ideas that were applicable and implementable in the Bangladeshi context.

The assessment team categorized its findings into five broad blocks. In the first block, Knowledge, Attitude and Perception mapping of youth and community, the team identified that there is currently a prevailing deficit of accurate information resulting in rapid misinformation. The team identified three major problems: the invisibility of air pollution which results in people associating its potential health impact with more visible or perceivable causations, e.g. people associating poor health with climate change. A consistent attempt at disassociating from the problem, where it was observed that individuals were reluctant to accept that their actions may result in pollution. Finally, a perceived notion that the impact is disproportionate, where families belonging to the upper socioeconomic class were of the opinion that only families and individuals living in poorer housing facilities (slums or houses next to industries) were the only ones being affected. In the second block, the assessment team noted that children and pregnant women were particularly vulnerable to air pollution. When pregnant women are exposed to polluted air, they are more likely to give birth prematurely, and have small, low birth-weight children. Air pollution also impacts neurodevelopment and cognitive ability and can trigger asthma, and childhood cancer. In the third block, the assessment team identified that brick kiln emissions, vehicular transport, and construction dust were amongst the biggest pollution sources in the urban context, particularly in Dhaka. In the fourth block, the team conducted a global benchmark analysis and detected that there has been an increase in youth-led, community driven intervention ideas that leveraged technological advances to address urban air pollution. (see Global and Local Community based/youth led practices addressing Urban Air Pollution section for case studies) In the final block, the assessment team assessed the global funding landscape and found that funds to address air pollution constituted only a fraction of global aid. Furthermore, the team also identified that funding from international foundations primarily focused on awareness and

communication, and policy advocacy whereas funding from government sources generally focused on implementation projects.

Following a rigorous intervention filtration process and supplemented with the assessment team's findings, the final intervention options were designed following two primary frameworks. The first framework, designed by the Department of Environment in the Air Pollution Reduction Strategy Paper (2012) consisted of six main blocks: Regulatory and Fiscal reforms, Research and Development, Capacity building and Knowledge Retention, Awareness and Motivation, Cooperation and Coordination, and Institutional Reform. The assessment team found that while some work was being done in the research and development block, there was still a gap in the remaining five. The team designed the intervention options to address these gaps. The second framework, through which the intervention ideas underwent, consisted of three blocks: impact, community engagement, and alignment with World Vision Bangladesh. The final set of intervention options that were derived had a high degree of impact and engaged the community and youth inclusively, with particular emphasis on the community's more vulnerable cohorts, i.e. children, women. A summary of the intervention options table can be found below. The table outlines the options, states the term for each intervention option, and identifies potential partnership opportunities.

Intervention Options Summary Table

TERM	Description	Potential Partnerships Government	Private	Others
Short Term	Develop a series of *Edutainment Content* for youth and children to inform them about air pollution and facilitate behavioral change.	ICT ministry, Department of Environment, Ministry of Environment, Forest and Climate Change, Ministry of Education	, Animation Studios, Content Creators,	USAID (SISIMPUR)
Short Term	Organize an Incubator to help youth-led initiatives focusing specifically on addressing Urban Air Pollution in the Bangladesh Context, should engage local entrepreneurship ecosystem to leverage existing technical expertise, feasibility assessments and funding options	A2I innovation lab, iDEA project	Bangladesh Angels, Angel Investment,, GP Accelerator	
Short Term	Facilitate Awareness and Dissemination Campaign aimed at skilling Construction Contractors, Local Construction Labor Force, and Real Estate Developers on usage & benefits of Green Bricks to help faster and efficient transition towards environment-friendly construction.	Rajdhani Unnayan Kartripakkha, Department of Environment, Ministry of Environment, Forest and Climate Change, Ministry of industries	Real Estate and Housing Association of Bangladesh, Bangladesh Brick Manufacturing Owners Association	OXFAM, UNDP
Medium Term	Contribute to improving the local Electric Vehicle Infrastructure by conducting holistic skilling and inclusion of automobile industry workforce including standalone technicians.	Infrastructure Development Company, Ministry of Industries, Bangladesh Road Transport Authority	Bangladesh Auto Industries Limited, Electric Bikers Association of Bangladesh, Runner Automobiles, Nitol Motors	Asian Development Bank
Medium Term	Commission the development of an app that disseminates customized and localized air quality data to inform the public, raise awareness and encourage initiatives from the community level.	Department of Environment, Ministry of Environment, Forest and Climate Change, ICT ministry	App Developers	US Embassy
Long Term	Launch a public-private dialogue platform to policy advocacy to formulate new policies or strengthen existing industrial and construction emission guidelines necessary for proper enforcement and regulation of emissions and engage in capacity building of construction sector workers	Ministry of Industries, Bangladesh Road Transport Authority, Ministry of Road Transport and Bridges, Rajdhani Unnayan Katripakkha	Real Estate and Housing Association of Bangladesh,	UNDP, Bangladesh Poribesh Andalan
Long Term	Engage in policy advocacy to strengthen monitoring of existing environmental guidelines to incorporate planned urban biodiversity in current and upcoming urbanization at a citywide scale.	Rajdhani Unnayan Katripakkha, Dhaka North City Corporation, Dhaka South City Corporation, Department of Environment,	CSR divisions of private sector entities	Bangladesh Environment and Development Society,

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Abbreviations

UAP	Urban Air Pollution
PM	Particulate Matter
GE	Gaseous Emission
D.Int	Direct Interventions
I.Int	Indirect Interventions
A.Int	Awareness Interventions
ERI	Emission Reduction Interventions
PRI	Pollution Reduction Interventions

3. Note for the Reader

This study was commissioned by World Vision Bangladesh to identify key intervention areas to address Urban Air Pollution through a Community Based Approach. Following this criterion, the study was conducted to filter out intervention options which apply to the Bangladeshi context and adhere to these two major criteria points.

Based on this, this report was developed to be a document to inform initiatives and help develop interventions suited to World Vision Bangladesh. The information gathered from the major sector actors, government agencies, environmentalists, academicians and also the representatives of different segments of the population was then assessed through this lens.

The document follows the format of an Option Analysis Report (similar to the sectoral analysis report format used by USAID and other such organizations). As such, this report discussed intervention options with associated context and analysis, as opposed to traditional formats where all analysis is done in one section regardless of which intervention it may apply to, and the intervention framework is kept separate.

In the section discussing intervention options, each option begins with context relevant to the intervention, suggestions on actionable steps which lead to a net positive impact on urban air pollution, and associated limitations. This approach is useful because it presents the reader with succinct overviews of the background relevant to each intervention type and shows a clear line of reason towards the suggested engagement points.

1 Introduction

1.1 Background

Air pollution in Bangladesh is gradually reaching a critical point particularly in the urban clusters across divisional cities. An ever-increasing population due to improvements in maternity and neonatal care and continuous migration into the cities from rural areas have had an unprecedented impact on the emissions caused by the cities. Despite having a landmass that's roughly only .21% of Bangladesh, Dhaka is currently the residence of about 6.21% of the country's population. Some of the most common causes of air pollution, such as industrial emissions, high density of outdated vehicular emissions, and high population density and informal urbanization which are often consequences of development. Bangladesh, which has recently graduated from the least developed nations list to the developing nations category, has seen a massive drop in air quality.

To address this issue many major stakeholders have undertaken steps to root out the problem from different vantage points. In the 'Air Pollution Reduction Strategy for Bangladesh' (Department of Environment Government of Bangladesh, 2012)[1], published in 2012, the Department of Environment (DoE) of the Ministry of Environment, Forest and Climate Change, Government of Bangladesh indicated major areas of concern currently under their radar. The government plans to take comprehensive steps to address issues related to infrastructure, industry emissions, vehicle emissions, and energy production among others through use of appropriate technological advancements as well as the enforcement of targeted regulations and standards. The government is not the only concerned actor taking up initiatives to address the issue. Concerned members of the overall ecosystem, be they NGOs, CSOs, private sector actors, are undertaking initiatives on a broad scale to tackle the issue of urban air pollution.

However, there is still much cause for concern. Since 2020 Bangladesh has consistently been in the top 5 on the list of Countries with the Worst AQI (US) list, with frequent visits to the top spot. Bangladesh had an average PM2.5 concentration of 77.1 micrograms per cubic meter of air (µg/m3) in 2020, which is seven times above WHO exposure recommendation. This deteriorating quality of Air causes many air-borne diseases including ischemic heart disease, stroke, chronic obstructive pulmonary disease (COPD), lung cancer, and acute lower respiratory infections in children. Given present circumstances, it is imperative to direct greater attention towards the problem of UAP.

In response to this, World Vision Bangladesh has commissioned this study, aimed at analyzing the existing and new possible options to identify high potential interventions to address urban air pollution in Bangladesh.

[1] Air pollution Reduction Strategy for Bangladesh – Department of Environment – 2012
http://old.doe.gov.bd/publication_images/60_air_pollution__reduction_strategy.pdf

1.2 Major concepts relevant to the assignment

The problem of air pollution is something that has been discussed for quite a long time, and as such, there are many ideas and concepts that need to be defined for the sake of clarity. In this section, we will be presenting some definitions of certain major concepts relevant to the study, which will help with a uniform understanding for all relevant stakeholders.

Urban Air Pollution (UAP):	This refers to the air pollution in and around cities. Denser populations experience UAP in greater degrees, and it affects human health as well as the climate of an area.
Particulate Matter (PM):	This, according to the United States Environmental Protection Agency (U.S. Environmental Protection Agency, n.d.)[2], refers to the mixture of solid particles with liquid particles present in the air.
Gaseous Emission (GE):	This refers to the emission of gases that either facilitate harm or are deemed harmful to the environment.
Direct Interventions:	This refers to intervention ideas or techniques where the primary purpose of the intervention is to address UAP in some form. This may or may not have additional effects/impacts.
Indirect Interventions:	This refers to intervention ideas or techniques that have something other than addressing UAP as the primary goal, but also addresses either UAP or a source of air pollution as a side effect. These ideas include initiatives which acknowledge that impact on UAP as well as ones which don't directly address it.
Awareness Interventions (A):	This type of intervention aims to increase the information available to the target population to help them make informed decisions regarding UAP.
Emission Reduction Interventions (ER):	These types of interventions are aimed at reducing the amount of emissions released from a polluting source.
Pollution Reduction Interventions (PR):	These types of interventions are focused on reducing the amount of pollution already existing in the air, i.e., cleans the air.

Table 1: definition of terminology

[2] Particulate Matter (PM) Basics - U.S. Environmental Protection Agency - https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

1.3 Community-Based Approach

A community-based approach refers to the process of engaging in operations/interventions/initiatives with purposeful inclusion and integration of the people and persons who are either direct or indirect stakeholders to the cause. This is done for multiple reasons, key among which are

- Community-based approaches help leverage the wide range of skills brought in by the members of the greater community which may not be inherent within the members of the core operational team. This helps capitalize on additional skills resources and also builds on the experiences of residents which helps bolster the interventions.
- A community-based approach can help communities work to prevent social problems and to deal directly with those that do arise, instead of having external actors step in and assume these responsibilities.
- Community-based approaches allow for representatives of the community to help establish familiar cultural patterns and support structures (UNHCR, 2008)[3], which then helps with sustainability through collective participation.

1.4 Objective

World Vision Bangladesh has commissioned this study aimed at analyzing the existing and new possible options to identify high potential interventions to address urban air pollution in Bangladesh. The objectives of the study are indicated below:

1.4.1 Broad objective

1. To suggest World Vision Bangladesh urban programming team on a probable community-based approach to address urban air pollution in Bangladesh.

1.4.2 Specific objectives

1. To arrange an innovation challenge competition to crowdsource the ideas from the youth of Bangladesh
2. To understand the perception or awareness of youths about the Urban Air pollution problem
3. To identify existing community based/youth-led models to address Urban Air pollution (from government, private sectors, or development sectors) in Bangladesh, South Asian countries, or developed countries
4. To recommend feasible, low cost, innovative and community-based approaches to address Urban Air pollution

[3] A Community-based Approach - UNCHR - https://www.refworld.org/pdfid/47da54722.pdf

2 Methodology

The study methodology outlined below discusses how the study team engaged in the different stages of the study in order to collect data and assess the information in keeping with the objectives of the study. The study was constructed with three core building blocks that will work with each other to gather and validate the information required for the study.

1. Block 1: Youth Innovation Crowdsourcing: The Idea Competition
2. Block 2: Global Benchmarking
3. Block 3: Idea Validation

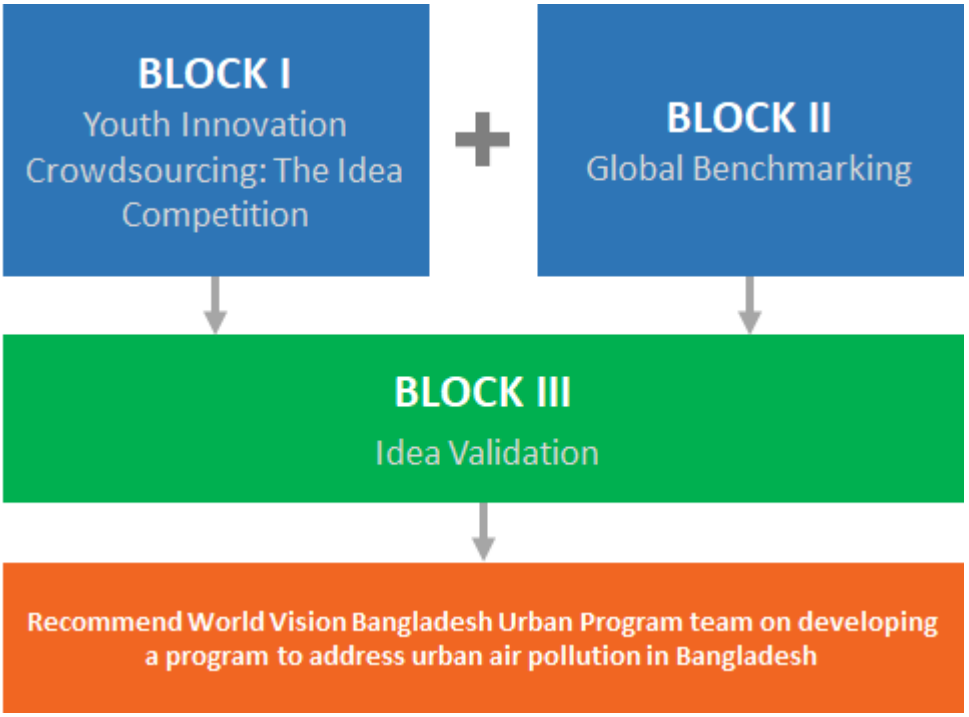


Fig 1: Methodology

The first two blocks will be the primary resource for collecting actionable ideas to address air pollution. To understand the current level of awareness, urgency and initiative from the citizens of the country, Block 1 will utilize Bangladesh's youths to crowdsource ideas to address air pollution in the country. Block 2 will analyze global and local efforts already made over the past few decades to address air pollution on small to large scales. The collected ideas from the first two blocks will then be validated in Block 3 by conducting Key Informant Interviews (KII) and Focus Group Discussions (FGD).

By combining the results from these three blocks, the study then provided recommendations to World Vision Bangladesh to create a program or a set of programs to address air pollution in Bangladesh on a community level.

2.1 Block 1: Youth Innovation Crowdsourcing: The Idea Competition

The youth of Bangladesh has already been quite active in showing their creativity, innovation, and dedication to introduce positive change in the country. Each new generation is showing even more prowess than the last. However, there seems to be a clear gap in such innovations when it comes to

addressing air pollution in Bangladesh's urban areas. As such, the first building block for the study was to fill this gap by presenting the youth with the proper opportunity to address it.
Globally, the youth have historically been responsible for many impactful ideas that have addressed many issues along with air pollution. This is typically achieved by holding competitions that act as a platform for youths to access easily and participate. We planned to do the same. By organizing a nationwide idea competition that opens the door for the youths to participate and show their innovations to the nation. As a tried-and-true method of inspiring innovation and creation all over the world, this allowed the youth to showcase their innovation and shed light to potential ideas that may play a role in addressing air pollution in Bangladesh. While also spreading awareness about the current situation to the masses.

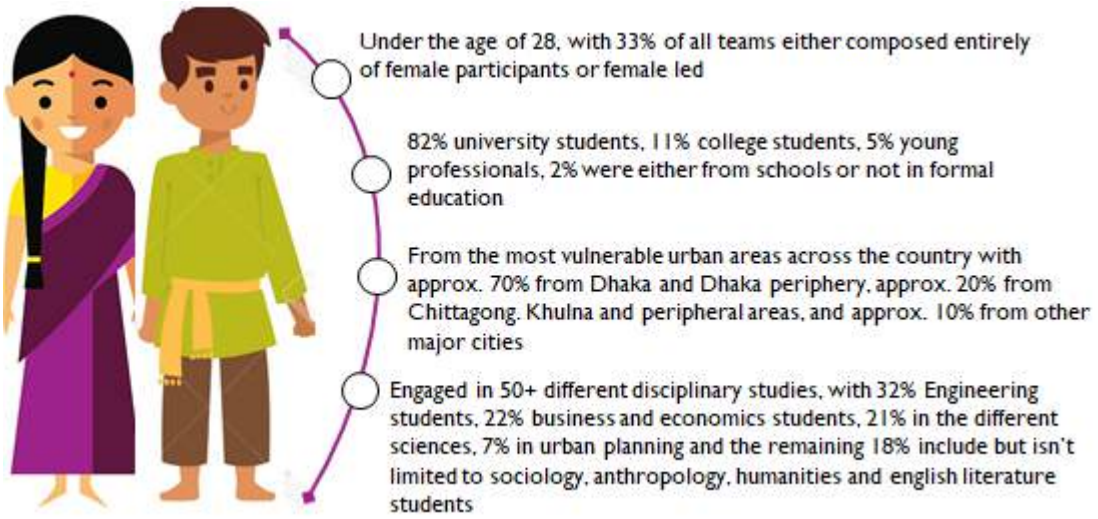


Figure 2: Key Participant Insights at the time of registration

The competition was held fully online and promoted using online media platforms. There were three rounds in the competition to allow the selected ideas to develop into presentable business models, ready for investors, incubators, and relevant stakeholders. Mentors were assigned to the participants who progressed to Round 3 to help the finalists polish their business models to their best. The top ideas were given the opportunity to get investors and incubators to develop and launch their model to the market/community. Others got certification for participating in the competition along with networking opportunities with relevant stakeholders. The competition garnered nationwide interest and had a total of 168 registrations. Of the 168 registered teams, 90 teams participated in the first round and 21 teams of the 90 made it through to the second round. The third and final round comprised of the top 9 teams from the 21 teams that participated in the second round.

Block I Challenges

Methodology Challenges	Accessibility challenges for participation in the innovation challenge
Context The competition was held entirely online to ensure standard covid-19 social distancing protocol. The study team apprehended that online-based competitions may hinder those individuals with no access to internet/computers/smart phones.	Mitigation ● The competition was held after approximately 14-15 months of Covid-19 lockdown, and the competition, by design, targeted youths studying primarily in universities. These youth groups were, by then, already well oriented with the online classroom modality (most universities were taking classes online) and possessed the necessary facilities (internet, smart devices) to participate in those classes. The study team leveraged this widespread adoption to facilitate equal participation in the competition ● Aside from promoting the competition online on social media, the team recruited campus ambassadors who also promoted the competition offline (word of mouth, postering) to ensure it reached youths not participating in social media. Offline promotion enabled individuals with an interest in participation but with no access to the internet to prepare for the competition (leverage FnF internet, computer resources) and participate accordingly

Table 2: identifies challenges and mitigation

2.2 Block II: Global Benchmarking

Inspira conducted a global benchmarking to find out the initiatives undertaken by the youth-led groups of different countries to reduce the air pollution problem. The core purpose was not to be limited within the scope of Bangladesh only. The cases were divided into 3 cohorts, and these were:

- Cohort 1: Cases of youth-led or community-based initiatives to address urban air pollution initiatives from Bangladesh
- Cohort 2: Cases of youth-led or community-based initiatives to address urban air pollution initiatives from South Asian countries
- Cohort 3: Cases of youth-led or community-based initiatives to address urban air pollution initiatives by developing countries from other regions

While assessing the cases from the above countries we applied a framework of selection entailing the following characteristics:

- Community-based ideas
- Youth mobilized initiatives

- Ideas that are direct/indirectly addressing urban air pollution
- Initiatives that have adopted digital technologies etc.

2.3 Block III: Idea Validation

Block III of this assignment employed a mix of qualitative tools for the data collection which allowed for broad interactions with the various stakeholders. Inspira conducted a qualitative study to gather insights about the perception of youth regarding urban air pollution and crowdsourced some community-based- youth-led projects addressing this.

2.4 Qualitative Method

Qualitative research focused on inductive reasoning, subjective understanding, and detailed and holistic data. In general, these goals were best met through intensely investigating a relatively small set of systematically selected samples. There were no set rules for determining the sample size in a qualitative study. In principle, the Saturation Principle should guide the sample size determination, whereas data collection was conducted until additional data brought no new insights. (Wolff et al., 2019, #)[4]

- **Desk Research: Systematic Review & Meta-analysis[5]:** Inspira team undertake a review of existing research findings, documents, dataset, and reports of review of the project documents, logical frameworks, and secondary literature on project objectives, beneficiaries' details. Desk review will be instrumental in developing the study tools, identifying key sources, and in revising the research plan when required. Inspira Team will conduct a deep dive secondary research.
- **Key Informant Interview (KII):** Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a wide range of people, including community leaders, professionals, or residents, who have firsthand knowledge about the community.

Inspira team connected with sector experts, government officers, activists, key personnel from development sector practitioners, and private sector actors in key informant interviews. We conducted 20 KIIs representing five selected cohorts which will give further insight into which ideas were feasible and actionable. The selected cohorts were –

- Government organizations (KII- 5)
- Development sector (KII- 5)
- Private sector (KII- 2)
- Academician/Sector's expert (KII- 4)
- Activist (KII- 4)

[4] Brent Wolff, Frank Mahoney, Anna Leena Lohiniva, and Melissa Corkum. (Collecting and Analyzing Qualitative Data)

[5] **Systematic reviews** are specific types of literature reviews that collect and critically analyze multiple research studies or papers, and then find and analyze studies that relate to and answer those questions in a structured methodology. They are designed to provide a complete, exhaustive summary of current literature relevant to a research question. **A meta-analysis** is the use of statistical methods to summarize the results of these studies.

The purpose of KIIs was to understand their suggestions on how the youth and different communities in Bangladesh can be utilized to address air pollution in their organizations and their own expert opinion on solving issues born from air pollution. Due to the current pandemic situation, the KIIs were conducted through virtual sessions.

- **Focus Group Discussion (FGD):** A Focus Group Discussion (FGD) is a qualitative research method and data collection technique in which a selected group of people discusses a given topic or issue in-depth, facilitated by a professional, external moderator.

In the FGD, the Inspira team conducted 8 Focus Group Discussions where it ensured the participation from the following demographics:

- Youths from different income groups, Gender, Age, Education Level, and other relevant cohorts
- University students from diverse departments
- Not in Education, Employment, or Training (NEET)
- Young Professionals who have recently graduated and are involved with income-generating activities
- Families in early stages (Newly married, New Parents)
- Low-income group representatives

Due to the current pandemic situation, the FGD was conducted through virtual sessions.

2.5 Geographical Scoping

The geographical scope of the study was formulated ensuring that there is nationwide inclusion of youth during the idea generation process. Thus, the Block I: Youth Innovation Competition of the study was provided nationwide coverage to ensure widespread youth participation. During Block III: Idea Validation Phase, the geographical scope consisted of the two major and highly polluted cities, Dhaka and Chattagram. Thus Focus Group Discussions were conducted with informants from Dhaka and Chattagram to ensure idea feasibility among youth groups. Key Informant Interviews were conducted with technical experts based in Dhaka and Chattagram but with those who play the role of nationwide representatives.

Type of Data Collection	Geographical Scope
Innovation Challenge	The innovation challenge received nationwide exposure, with notable participation from areas with high degrees of air pollution (major cities and peripheral areas).
Key Informant Interviews	Key Informant Interviews were conducted with informants from Dhaka and Chattogram but included nationwide representatives of the GoB, Associations, Academic Bodies and Activist Organizations.
Focus Group Discussions	Focus Group Discussions were conducted with informants from Dhaka and Chattogram.

3 Global and Local Community based/youth led practices addressing Urban Air Pollution

This section discusses some prominent interventions initiated and operated by the youth or other members of the community which work to address urban air pollution or major sources of air pollution. Given the nature of the different interventions, they have been classified as Direct and Indirect.

3.1 Direct Interventions addressing UAP

This refers to intervention ideas or techniques where the primary purpose of the intervention is to address UAP in some form. This may or may not have additional effects/impacts. The direct interventions mentioned below have been designed with UAP in mind and address UAP either by raising awareness or directly reducing pollution or emissions.

3.1.1 Air Bear

Country	Intervention Type	Period	Actor Type	Intervention Description
Yangon, Myanmar	Awareness	December 2019 - Present	Youth group	Raising awareness of the growing air pollution problems through a creative campaign

Table 3: Intervention Categorization

Caption 1:

As per the World Health Organization (WHO), air contamination adds to 22,000 deaths in Myanmar consistently and causes ongoing respiratory illnesses for some more. Yangon's deteriorating air quality is regularly ascribed to the sensational expansion in vehicles since imports were changed in 2011 and the comparing expulsion of trees to clear a path for traffic and advancement, notwithstanding, different factors like production line emanations, cooking with charcoal, and consuming junk assume a bigger part. (Ragavan, 2020) [6]

It's normally hard for residents in Yangon to get air quality information that can assist

6 Case study: Stuffed bear mascot used to illustrate Air Pollution - PRWeek - July 15, 2020

https://www.prweek.com/article/1689456/case-study-stuffed-bear-mascot-used-illustrate-air-pollution

with advising everyday choices like whether to wear a face cover or masks or to go outside at specific times.

A gathering of Yangon's students had brought issues to light of the nation's developing air contamination issues through an imaginative mission, dispatching a first-of-its-sort crusade named 'Air Bear'. Through their resident science project, Air Quality Yangon (AQY) started estimating the air quality across the city and began presenting these readings on their own Facebook page twice a day. Dr. Air Bear, a monster teddy bear model, produced using white cotton, highlights their mission and was planned as a public showing that has the effect of air contamination more visual to general society. Dr. Air Bear was visited all through the roads on a little cart-like stage all through the mission. As the days passed, contamination made the bear's hide turn more obscure. Following fourteen days of battling, Dr. Air Bear woke up in a human-size ensemble to demonstrate practices that were all the more harmless to the ecosystem, like strolling to work and taking public vehicles. Alongside the bear's monstrous appeal to people on foot, the AQY group utilized Dr. Air Bear's appearances to connect with the public one-on-one and offer their insight about air contamination.

Caption 2:Air Bear Mascot

The campaign has reached almost 7 million people on social media and gained 20,000 followers to Air Quality Yangon's own Facebook page. The group's campaign has also been covered by almost every major media outlet across the country.

3.1.2 Chakr Shield

Country	Intervention Type	Period	Actor Type	Intervention Description
Delhi, India	Emission Reduction	2016 - present	Youth group	Capturing emissions from diesel generators and converting PM into base pigment for black inks and paints

Table 4: Intervention Categorization

Caption 3: Chakr Shield Team

The startup was established by IIT Delhi graduate students, Chakr Innovation utilizes state of the art innovation to catch emanations from diesel generators and convert contamination causing particles into a base color for dark inks and paints. It is at present working in Delhi/NCR, Pune, and Bengaluru. It has worked in relationships with organizations like Titan, Hindustan Petroleum, and Indian Oil Corporation. Chakr Innovation has been subsidized by Globevestor, IDFC Parampara Fund, and IAN Fund (yourstory, n.d.).[7]

Chakr Innovation is unmistakably focused on settling the vehicular contamination issue. They additionally anticipate working with the public authority of India to assist with accomplishing the public level objective of a 20%–30% decrease of particulate matter ($PM_{2.5}$ and PM_{10}) by 2024 as proposed under the National Clean Air Program.

The organization's gadget, called the Chakr Shield, catches ash particles by suspending them in fluid-structure, keeping the little ash particles from turning out to be airborne once more. When the particles are settled with substantial metals are isolated, and the shade is separated, and a cover is added to make ink. The Chakr Shield fits in the fumes line of a diesel generator and catches 70 to 90 percent of the particulate matter produced as motor fumes. They have so far introduced 70 particulate-catching machines and guarantee to have decontaminated around 50,000 billion liters of air that would have in any case gone unfiltered into the air.

7 Chakr Innovation - Your Story - https://yourstory.com/companies/chakr-innovation/amp

3.1.3 Biotech Energy Limited

Country	Intervention Type	Period	Actor Type	Intervention Description
Dhaka, Bangladesh	Emission Reduction	2017 - present	Youth group	Recycling waste cooking oil into biodiesel and glycerin

Table 5: Intervention Categorization

Caption 4: Biotech Energy

Overheated cooking oil used for food-preparation restaurants, cafes, eateries are harmful for health and contaminate soil and water when disposed of to the environment.

The rehashed utilization of a similar clump of preparing oil for getting ready food likewise triggers the arrangement of Trans Fatty Acid, which the National Heart Foundation has connected to heart illnesses in customers.

In 2016, Hamid designed a machine for converting waste cooking oil into biodiesel and glycerin, which he started selling to industrial facilities in the Dhaka area (Kashem, 2020).[8]

Biotech Energy (BE)– the first such plant in the nation – reuses six tons of waste cooking oil each month to convert 5.4 tons of biodiesel alongside glycerin. Hamid, who is head of the organization, focuses on accomplishing a yield of 100 tons of biodiesel. The BE plant was constructed with the award of 19 Lakh Tk from the a2i Innovation reserve- a GoB fund in 2020. One liter of used cooking oil produces 900 ml of biodiesel and 100 ml of glycerin. The company is selling biodiesel at 60 Tk per liter (Kashem, 2020)[9] to dispatches, liners, and vehicles by blending it in with petrodiesel in a 5%-10% proportion. 90% petrodiesel and 10% biodiesel blend no mischief to vehicle motors.

The Biotech group fabricated a reactor that presently makes 1000 liters of biodiesel consistently. Their item has been broadly tried. It discharges 30% less carbon than non-renewable energy sources and is four percent more proficient. It likewise makes less smoke. The Biotech Energy Limited model is intended to fill in directly with the economy and dramatic industrialization. Biotech Energy Limited expects to cause an immediate commitment to the confirmation of maintainability to make up for the worldwide economy's carbon impression (Biotech Energy Limited, n.d.).[10]

[8] When waste turns into black gold - The Business Standard - 11 October, 2020 - https://www.tbsnews.net/economy/industry/when-waste-turns-black-gold-143962

[9] When waste turns into black gold - The Business Standard - 11 October, 2020 - https://www.tbsnews.net/economy/industry/when-waste-turns-black-gold-143962

[10] https://biotechenergybd.com/

3.1.4 AirMate

Country	Intervention Type	Period	Actor Type	Intervention Description
Dhaka, Bangladesh	Reducing pollution	2019 - present	Youth group	Invented an intelligent air purifier that allows the person wearing it instead of inhaling polluted air to have it purified by the filter

Table 6: Intervention Categorization

Dhaka positioned 6th for the most noticeably terrible air on the planet with a score of 151 on the ongoing US Air Quality Index (AQI), yesterday. Its air quality was depicted as "undesirable." This city reliably fights with horrible air contamination, making it hard to relax. Five of the main 10 reasons for death in Bangladesh are identified with air contamination (Chaity, 2019).[11]

In a nation where individuals smoke uninhibitedly, building locations don't keep contamination related standards, industry and vehicles discharge noxious black smokes, what could be the preferred arrangement over a wearable, electronic, air-filtering gadget that doesn't cover the entire face, yet viably cleans the demeanor of pollutants, microorganisms, and lethal diseases.
TechGeeks has developed a smart air purifier called AirMate, a gadget that permits the individual wearing it rather than breathing in contaminated air, to have it purged by the channel. They are attempting to propel a minimal expense filtering gadget. The channel in the gadget will continually cleanse the air around an individual, without expecting to cover the individual's whole face. Furthermore, the gadget is advantageous to such an extent that it very well can be fixed to one's shirt neckline, and it will take care of its job.

In addition, the contraption has a gas identifier sensor to distinguish unsafe gases and a three-layer filtration framework gives 99.98% exactness while recognizing harmful gases for cleansing. A portable application will ceaselessly inform the client about the air status.

[11] Bangladeshi startup developing project to combat air pollution - Dhaka Tribune - May 27th, 2019 - https://www.dhakatribune.com/bangladesh/nation/2019/05/27/bangladeshi-startup-developing-project-to-combat-air-pollution

3.1.5 Nanoclean

Country	Intervention Type	Period	Actor Type	Intervention Description
Delhi, India	Reducing pollution	2017 - present	Youth group	*Nasofilter* developed using nanotechnology, which ensures easy breathing and prevents the entry of harmful air pollutants (PM2.5) (Nano Clean, n.d.) [12]

Table 7: Intervention Categorization

Caption 5: Nanoclean team

The disturbing degrees of air contamination dangers in India can likewise be checked from a WHO report distributed last year. 9 out of the 10 dirtiest urban communities of the planet were from India, while Kanpur was the world's most contaminated urban community and Delhi remained at the 6th spot with $PM_{2.5}$ of 143 cities (Dewan, 2019). [13]

Hailing from the western Rajasthan, Prateek Sharma, was familiar with air emissions of Delhi. He saw a prominent need to make an item that could be a powerful tool in battling air toxins (Pema, 2018). [14]

Nanoclean, is a nanotechnology based *nasofilters* developed to clean air for urban dwellers. The three graduate students of IIT Delhi Prateek Sharma, Tushar Vyas, and Jatin Kewlani in February 2017 developed this *nasofilter* - which can be worn on the nose to protect from dust and particles and gives protection up to 12 hours without wearing face masks.

The organization has been seeing a hearty interest since the time it began activities in the country. While, in the peak season it gets orders between 20 - 30 lakh units per month, in the offseason (May-August), it is around 2-3 lakh units.

[12] https://nanoclean.store/

[13] Breath of fresh Air Nanoclean A Novel Way to Help City Dwellers - The Economic Times - Mar 14, 2019, - https://economictimes.indiatimes.com/small-biz/entrepreneurship/breath-of-fresh-air-nanoclean-has-a-novel-way-to-help-city-dweller

[14] How entrepreneur Prateek Sharma is winning the war on air pollution at just Rs 10 with Nasofilters - Your Story - November 6, 2018 - https://yourstory.com/2018/11/entrepreneur-nasofilters-prateek-sharma/amp

3.1.6 The Makrail Auto Green Bricks project

Country	Intervention Type	Period	Actor Type	Intervention Description
Faridpur, Bangladesh	Emission Reduction	2019-present	Industrialists	Makrail Auto Green Bricks is a gas fired (from coal gasification) automatic clay brick manufacturing facility. The factory uses a multi-staged, mechanized green brick processing system, to produce high-quality products using less energy and producing significantly less pollution than traditional brick kilns.

Table 8: Intervention Categorization

Caption 6: The Makrail Auto Green Bricks factory in Faridpur, Bangladesh (photo credit: Yekbun Gurgoz)

Dhaka, Chittagong, Khulna are the cities where urbanization and development is blasting. In Bangladesh, the development area is driven by a solitary fuel: blocks of bricks. However, making bricks is not flawless. It is untidy and backbreaking for the workers involved in this occupation. In Bangladesh, most bricks are physically produced using mud, and afterward consumed in ovens. Laborers need to go through sleds to break huge loads of coal each day. Then, at that point they convey the coal on their shoulders to the broilers used to fire bricks. There are in excess of 4,500 conventional brick kilns in Bangladesh that work along these lines (SARRAF & CROITORU, 2012).[15] The nation's capital, Dhaka, is encircled by in excess of 1,200 brick kilns. Most kilns are half the year (from November to April) as 90% of the brick-kilns are situated in low-lying regions which experience flooding during monsoon. During their operation times Dhaka becomes the most contaminated urban community that is already grasping with air pollution. The smoke is thick and

[15] Cleaner Bricks for Better Air Quality in Dhaka - World Bank - FEBRUARY 08, 2012 - https://blogs.worldbank.org/endpovertyinsouthasia/cleaner-bricks-better-air-quality-dhaka

contains fine particulates, which are exceptionally harmful for the wellbeing of the residents. They cause more than 20% of the premature deaths due to the metropolitan air contamination in Dhaka.

Makrail Auto Green Bricks are manufactured using the firing system of coal gasification. It has the capacity to produce 120,000 pieces of bricks per day. The manufacturing plant utilizes a motorized green brick preparing framework energy-efficient and has fewer air emission problems. The Housing and Building Research Institute (HBRI) has recognized this alternative brick building method and many private organizations and government bodies have started using the eco-friendly bricks.
The transition still has a long way to go. According to the latest statistics, to date only 134 HHKs and 47 Tunnel kilns have been installed. This is no more than 3% of total brick kilns operating in Bangladesh.

3.1.7 Satyam Thakur's clay pot filter

Country	Intervention Type	Period	Actor Type	Intervention Description
Bangalore, India	Emission Reduction	2019-present	Youth-led	Satyam Thakur, a Class XI student from Bangalore, designed a cheap filter made out of broken clay pots that can be fitted over car exhausts or even upscaled to cover the chimneys of factories.

Table 9: Intervention Categorization

Satyam Thakur, a Class XI understudy from Bangalore, decided he needed to track down a simple way for individuals to decrease their fossil fuel byproducts. He understood that the commonly used clay pots in numerous Indian families can be the safeguard of particulate matter pollution. Since clay pots are a crucial component in any Indian family, it is disposed of when it becomes broken or unusable. Since these pots are baked well before use, they don't break without any problem. He planned a modest channel made out of broken mud pots that can be fitted over vehicle debilitates, or even upscaled to cover the fireplaces of processing plants. After use, they would then be able to convert it into clay bricks for development, or reuse again. Moreover, he found that this material can be fit for water filters. Furthermore, it is made of easily available waste materials and very inexpensive and the design is also simple yet effective.

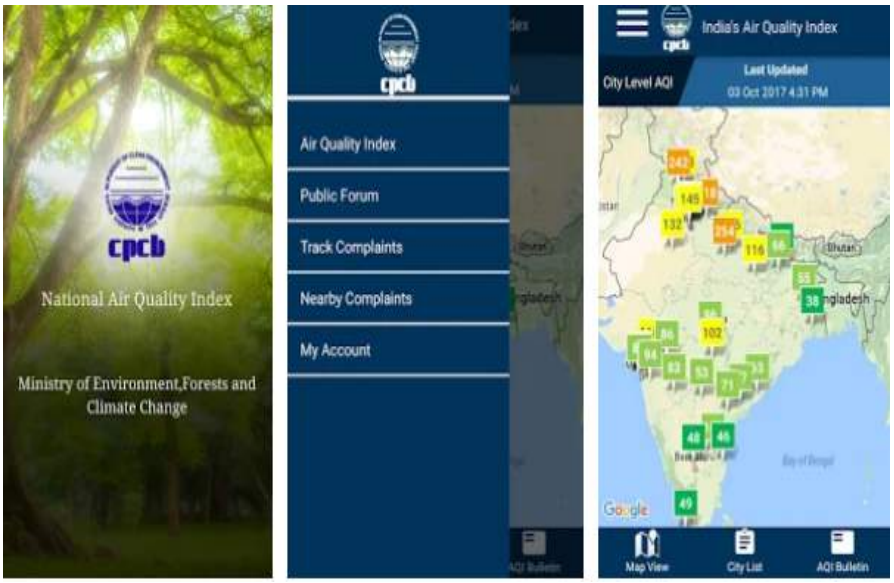
Caption 7: Satyam Thakur

1.1. Sameer Smartphone Application

Country	Intervention Type	Period	Actor Type	Intervention Description
India	Awareness ++	2019- present	Government	A government designed smartphone application providing users to track air quality and report instances of air pollution

Table 10: Intervention Categorization

The Sameer Smartphone Application, developed by the Central Pollution Control Board (CCPB) of India, is an application that provides real-time Air Quality information (AQI) parameters while leveraging user activism to address garbage dumping, road dust, vehicular emissions, etc. The application allows its users to file and track complaints regarding instances of events that may cause air pollution (e.g., garbage dumping, road dust), allowing CCPB to investigate the complaints and mitigate these problems.



Caption 8:App Interface

Providing Air Quality Information of over 100 cities on an hourly basis, the app has an easy-to-use user interface and categorizes each town based on its pollution level. This application acts as a direct intervention to address air pollution as well as raising general user awareness.

3.1.8 Blue Sky Challenge

Country	Intervention Type	Period	Actor Type	Intervention Description
Africa	Awareness	2020	Youth-led	This intervention began to raise public awareness of the importance of clean air for health and livelihoods, and to share promising practices being undertaken by communities, organizations and cities to combat air pollution.

Table 11: Intervention Categorization

Air contamination and environmental change compromise Africa's advancement on account of their adverse consequences on human wellbeing, prosperity, and usefulness. Air contamination and environmental change diminish horticultural efficiency, for instance, with food and dietary security (Cision, 2020).[16]

On 7 September 2020, the world celebrated the first-ever United Nations (UN) International Day of Clean Air for Blue Skies. This resolution (United Nations, 2020, #)[17] was adopted by the UN General Assembly in recognition of the need to address the health and climate impacts of air pollution, without which the Sustainable Development Goals (SDGs) cannot be achieved. This day allows highlighting the scale of the challenge, to raise public awareness of the importance of clean air for health and livelihoods. It also shares promising practices being undertaken by communities, organizations and cities to combat air pollution. One such initiative is the UrbanBetter #BlueSkyChallenge (Urban Better, n.d.)[18]. This project invites youth from across Africa to share, in their own words and language, what clean air means to them, what initiatives and solutions are being taken in their cities to improve air quality, and their perspectives on what they think their cities should be doing to tackle air pollution.

[16]Achieving Africa's development in a way that limits air pollution and climate change - Stockholm Environment Institute - https://news.cision.com/stockholm-environment-institute/r/achieving-africa-s-development-in-a-way-that-limits-air-pollution-and-climate-change,c3190049

[17] Resolution adopted by the General Assembly on 19 December 2019 - United Nations - https://undocs.org/en/A/RES/74/212

[18] https://www.urbanbetter.science/

3.2 Indirect Interventions addressing UAP

This refers to intervention ideas or techniques that have something other than addressing UAP as the primary goal, but also addresses either UAP or a source of air pollution as a side effect. These ideas include initiatives which acknowledge that impact on UAP as well as ones which don't directly address it. Interventions mentioned below have been originally intended to either replace or reduce dependency on fossil fuels, ensure proper waste management or provide support to vehicles to help them run more efficiently. Consequently, however, they have also indirectly contributed to the reduction in UAP, as explained in this section.

3.2.1 Solar Roadways

Country	Intervention Type	Period	Actor Type	Intervention Description
USA	Emission Reduction	2006- present	Startup	Indirect reduction of UAP via rethinking road construction

Table 12: Intervention Categorization

For technical details: http://large.stanford.edu/courses/2017/ph240/cook2/docs/mehta.pdf

Caption 9: Solar Roadways

Solar Roadways, a United States-based startup, has been active since 2006 with the ambition of rethinking traditional road construction. Replacing the highly polluting conventional roadways construction methods (using bitumen, concrete, asphalt) with solar panels, the startup aims to use these "solar panel roadways" to generate electricity while serving its intended purpose- a road for the movement of vehicles.

While the primary objective of the startup wasn't to address air pollution, replacing the use of crude oil derivatives (bitumen, asphalt) contributes to the overall reduction of air pollution. Furthermore, Asphalt is a significant source of urban air pollution, particularly on hot days/during hot weather/countries with a hot climate (Khare et al., 2020).[19] The paving process itself, which may require the heating of Asphalt, is also a significant source of UAP. The use of solar roads are being

[19] Peeyush Khare,, Ricardo Soto, Megan He,, R. Gentner, Asphalt-related emissions are a major missing nontraditional source of secondary organic aerosol precursors, Sep 2020: Vol. 6, no. 36, eabb9785, DOI: 10.1126/sciadv.abb9785

adopted at a global scale with implementations in the United States, Netherlands, and with the most recent being Japan's announcement to build solar roads ahead of the 2020 Olympics (LUTKIN, 2019).[20] However, updates on the implementation of such plans in Japan are unclear due to the global Covid-19 pandemic.

However, limitations of this innovation include its high construction and maintenance costs, drop in efficiency when not faced with direct sunlight, among others (Marquart, 2021).[21] Variations of solar-powered roads have emerged with instances of solar-powered pavements on driveways (Bergen, 2020).[22]

3.2.2 "Data Driven- Machine Learning Mechanic"- Smartphone Application

Country	Intervention Type	Period	Actor Type	Intervention Description
USA	Emission Reduction	2017- present	Startup	Indirect reduction of UAP by using machine learning technology via a smartphone application to detect mechanical issues in cars

Table 13: Intervention Categorization

For technical details: https://www.sciencedirect.com/science/article/abs/pii/S0952197617302294

Data Driven, a startup founded by a team of engineers at MIT, has created a smartphone application capable of detecting issues with vehicles based on engine sounds, car movement, among other key car health indicators. This cellphone application uses its microphone, GPS, and other detection features to detect these indicators.

The team of engineers added a database of different car engine sounds in the smartphone application and integrated machine learning capabilities into it so that the application can detect sound or movement patterns and connect to a possible diagnosis. The application is currently under development and claims to have a 90% accuracy rate in problem detection (Chandler, 2017).[23]

While the idea itself was developed to serve as a digital diagnostic tool for automobiles , it may have significant implications for addressing urban air pollution. Vehicles with optimized engines consume

[20] Tokyo Announces Plan To Install Solar Roads In Time For 2020 Olympics - Green Matters - MAY. 31 2019 - https://www.greenmatters.com/news/2018/06/11/ZdfqoX/tokyo-solar-road-olympics

[21] Understanding Solar Roadways: An Engineering Failure of Epic Proportions - Interesting Engineering - Mar 04, 2021 - https://interestingengineering.com/solar-roadways-engineering-failure

[22] First home solar pavement installed on a driveway - Inhabitat - Apr 6, 2020 - https://inhabitat.com/first-home-solar-pavement-installed-on-a-driveway/

[23] Let your car tell you what it needs - MIT News - October 25, 2017 - https://news.mit.edu/2017/software-let-your-car-tell-you-what-it-needs-1026

less fuel compared to vehicles running poorly.[24] Furthermore, unfit vehicles (Bisby, 2017)[25] emit a significant amount of black smoke (due to the inability to burn fuel). Exposure to black smoke can increase the mortality rate of individuals (Beverland et al., 2014).[26]. At present, the application is in development.

3.2.3 Road Construction- Reducing Bitumen use by plastic waste

Country	Intervention Type	Period	Actor Type	Intervention Description
Scotland	Emission Reduction	2016- present	Startup	Indirect reduction of UAP by using plastic waste during road construction and reducing the use of Bitumen

Table 14: Intervention Categorization

For technical details: https://www.researchgate.net/publication/350124383_Using_Local_Waste_Plastics_in_Asphalt_Modification_to_Improve_Engineering_Properties_of_Roads

"MacRebur, a Scottish company founded in 2016, was based on the principle that it will reduce plastic landfills by making better use of plastic waste. MacRebur grinds regular household plastic garbage into pellets and flakes, which can subsequently be used as a supplementary binder in asphalt mixes. This method does not necessitate any changes to asphalt factories. MacRebur's solution does not entirely replace bitumen, but it minimizes the amount needed depending on the surface being produced.

Caption 10: plastic beads

While the idea itself aims to reduce plastic waste, it indirectly addresses urban air pollution in two ways. Firstly, it reduces crude oil-derived bitumen use by replacing it with plastic pellets and flakes. This places downward pressure on the demand for bitumen production and hence reduces emissions in the process. Secondly, the idea minimizes the amount of plastic waste in landfills, the burning of which emits significant amounts of harmful particulate matter and gases and is a major source of air pollution (Verma et al., 2016).[27]

[24] Fundamentals of Fuel Consumption - The National Academies of Sciences Engineering and Medicine - https://www.nap.edu/read/12924/chapter/4#15

[25] Holy smoke! What does your exhaust smoke mean? - Stoneacre - https://www.stoneacre.co.uk/blog/holy-smoke-what-does-your-exhaust-smoke-mean

[26] I J Beverland, M Carderb, G R Cohenc, R M Agius (2014). Associations between short/mediumterm variations in black smoke air pollution and mortality in the Glasgow conurbation, UK. Environment International. 62: 126–132. DOI:10.1016/j.envint.2013.01.002

[27] Rinku Verma, K.S. Vinoda, M. Papireddy, A.N.S. Gowda, Toxic Pollutants from Plastic Waste- A Review, Procedia Environmental Sciences, Volume 35, 2016, Pages 701-708, ISSN 1878-0296, https://doi.org/10.1016/j.proenv.2016.07.069.

According to MacRebur, With each km of road laid using their products, they use up the equivalent weight of 740,541 one-time-use plastic bags while 1 tonne of MacRebur mix contains the equivalent of 80,000 plastic bottles. MacRebur's products are not just limited to road construction but are also applicable for car parks and driveways.

3.2.4 ADITYA: India's first solar ferry

Country	Intervention Type	Period	Actor Type	Intervention Description
India	Emission Reduction	2017-present	Government	A solar-powered ferry that isn't dependent on diesel and hence indirectly reduces emissions associated with diesel engines

Table 15: Intervention Categorization

Caption 11: Solar Ferry

Winner of the First Gussies Award for the Best Electric Ferry in the World in memory of Gustave Trouvé (Butler, 2020)[28], ADITYA is a solar-powered ferry operating in India. Designed by NavAlt Solar and Electric Boats (Navaltboats, n.d.)[29]It was completed in 2016 and began full operation in 2017.

Assuming a twenty-year lifecycle, and using Aditya's cost data(Capex, Energy, Finance and Battery Replacement) during its first year of operation, research suggests that throughout its lifetime, Aditya will cost approximately USD 370,000. In contrast, during a similar lifespan, a diesel ferry will cost three times more (Thandasherry, 2018).[30] As a result of its success, the State Government of Kerala's Water Transport Department has announced that it will replace all 48 diesel-powered ferries with solar-powered ones (Rajendran, 2020). [31]

ADITYA, has close to zero emissions and contributes to emission reduction indirectly when put into perspective with diesel powered water ferries.

[28] Winners of The 1st Gussies Electric Boat Awards - Plugboats - July 26, 2020 - https://plugboats.com/winners-of-the-1st-gussies-electric-boat-awards/

[29] https://navaltboats.com/

[30] Economics of ADITYA – India's First Solar Ferry - IEEE India Info. Vol. 13 No. 3 - Sep 2018 - http://ieeecs-madras.managedbiz.com/icnl/18q3/p38-p45.pdf

[31] Indian Solar Ferry Flies Flag for Cleaner, Cheaper Water Transport - Marine Link - August 13, 2020 - https://www.marinelink.com/news/indian-solar-ferry-flies-flag-cleaner-480911

3.2.5 Garbage Man

Country	Intervention Type	Period	Actor Type	Intervention Description
Bangladesh	Emission Reduction	2017-present	Startup	Garbageman collects waste to prevent it from going into landfills and hence indirectly reduces emissions from them.

Table 16: Intervention Categorization

Caption 12: Upcycled fertilizer

Garbageman is a Bangladesh-based startup that aims to reduce the amount of waste going into landfills. At present, it collects both organic and inorganic waste and turns the former into vermicompost, and the latter is upcycled to a third party. According to Garbageman calculations, as reported by a news daily, each kilogram of vermicompost equates to three kilograms of landfill waste being reduced (Shembil, 2020).[32]

According to Inspira extrapolation[33], waste in landfills are sources of gaseous emissions and even release particulate matter when they are burned. Since burning is a common rite of passage for garbage in landfills in the country, any intervention aimed at reusing waste and preventing them from ending up in landfills may be deemed an indirect intervention in addressing UAP.

[32] Garbageman: An architect's quest for a greener city - The Daily Star - Sep 6, 2019 - https://www.thedailystar.net/star-youth/news/garbageman-architects-quest-greener-city-1796056

[33] Inspira's Environmental Impact Consultant

4 Urban Air Pollution Intervention Potential in the Bangladeshi Context

Air pollution in Bangladesh is gradually reaching a critical point, particularly in the urban clusters across divisional cities. An ever-increasing population due to rapid urbanization has had an unprecedented impact on the emissions caused by the cities. Consequently, the influx in migration has resulted in increased use of transportation, construction of new buildings and roads, and therefore increased emissions. UAP is further worsened by the situation of multiple industrial areas near cities. It is also important to identify and understand which of the major causes of Urban Air Pollution is most prevalent in the urban areas of Bangladesh.

4.1 Traffic and Automotives

The increase in population in urban areas has resulted in a **greater number of automobiles in use** within the confines of the cities. These vehicles are often a significant source of UAP, particularly vehicles that aren't adequately maintained. Most of these vehicles are imported and reconditioned and already have engine capacity weakened. While hybrid or electric vehicles can be seen sporadically, most vehicles on the roads of Bangladesh are still powered by an internal combustion engine. Because of their harmful influence on air quality, human health, and global warming, emissions from internal combustion engines are especially worrisome. Unburned hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NOx), and particulate matter (PM) are all undesirable pollutants that are released into the air from these engines (Rizvi, 2009, 273-333). [34]

4.2 Construction

Building and road construction in urban areas are among the leading causes of outdoor air pollution in Bangladesh. According to a study by the Environment and Social Development Organization – ESDO, the major sources of outdoor air pollution in rural and urban areas is construction activities (38%) (*Dhaka 4th Polluted City Globally*, 2020).[35] Population growth in our country is increasing day by day, and the increasing population generates more demand for new buildings and roads. These have the effect of increasing the amount of particulate matter (from construction dust) as well as bitumen from the asphalt used in road construction. The situation of particulate matter in Dhaka city has remarkably deteriorated since the construction of different roads and highway projects such as BRT, metrorail etc. The clean air effect was well understood during the COVID lockdown in 2020.

[34] "Chapter 6: Emissions in an Internal Combustion Engine," in A Comprehensive Review of Lubricant Chemistry, Technology, Selection, and Design, ed. S. Rizvi (West Conshohocken, PA: ASTM International, 2009), 273-333.

[35] Dhaka 4th Polluted City Globally - ESDO - December, 2020 - https://esdo.org/dhaka-4th-polluted-city-globally-2/

4.3 Industrial Activities

The rise in the number of concentrated **industrial areas** within metropolitan cities is more significant than ever. Again, the brick kiln factories, which have been instrumental towards achieving rapid urban advancements, also contribute a lot to the rise of harmful emissions into the lower atmosphere. Most of these kilns use coal, wood, and old tires as their prime sources of energy, resulting in particulate matter, oxides of sulfur, and volatile organic compounds emissions in the atmosphere.

To address UAP, many major stakeholders have undertaken steps to root out the problem from different vantage points. In the 'air pollution Reduction Strategy for Bangladesh' (Department of Environment, 2012)[36], published in 2012, the Department of Environment (DoE), the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of Bangladesh indicated significant areas of concern currently under their radar. The government plans to take comprehensive steps to address issues related to infrastructure, industry emissions, vehicle emissions, and energy production, among others, through appropriate technological advancements and the enforcement of targeted regulations and standards. The government is not the only concerned actor taking up initiatives to address the issue. Concerned members of the overall ecosystem, be they NGOs, CSOs, private sector actors, are undertaking initiatives on a broad scale to tackle urban air pollution.

4.4 The Idea Matrix

The idea matrix shows the filtered Global (G) and Local ideas (L) and the range of their impact directly (D) or indirectly (I)

Implementation Type/ Implementation Feature	Awareness	Emission Reduction	Pollution Reduction
Traffic Congestion/Vehicle Efficiency	Sameer App (GD) Air Bear (GD) Blue Sky Challenge (GD)	Biotech Energy Limited (LD) Sameer App (GD) Satyam Thakur's clay pot filter (GD) Data Driven- Machine Learning Mechanic (GI) ADITYA: India's first solar ferry (GI)	AirMate (LD) Nano Clean (GD)
Industries/Households	Sameer App (GD) Air Bear (GD) Blue Sky Challenge (GD)	Biotech Energy Limited Garbageman (LI) Sameer App (GD) Chakr Shield (GD) Makrail Auto Green Bricks project (LD)	AirMate (LD) Nano Clean (GD)

[36] air pollution Reduction Strategy for Bangladesh – Department of Environment – 2012 http://old.doe.gov.bd/publication_images/60_air_pollution__reduction_strategy.pdf

		Satyam Thakur's clay pot filter (GD) Garbage Man-Youth-led organization (LI)	
Constructions/Machinery (Roads, Buildings)	Sameer App (GD) Air Bear (GD) Blue Sky Challenge (GD)	Biotech Energy Limited Sameer App (GD) Chakr Shield (GD) The Makrail Auto Green Bricks project (LD) Solar Roadways (GI) Road Construction-Reducing Bitumen Usage by using plastic waste (GI)	AirMate (LD) Nano Clean (GD)

Table 17: Idea Matrix

After a preliminary analysis, the following ideas may be filtered down for further research and scrutinization.

4.4.1 Biotech Energy Limited

The mixture of petrodiesel with 5-10% biodiesel(Biotech's product), emits 30 percent less carbon than fossil fuel and is four percent more efficient. It also creates less smoke. As a result, the product not only contributes to lower emissions but also makes a case for an improved and optimized engine operation. Taking into account the present traffic scenario in the country, particularly in urban areas, a widespread adoption of biodiesel with typical diesel may result in emission reduction. Furthermore, as backup power generators present in offices, factories, and households and used during construction are typically diesel-run, and are significant sources of UAP, Biotech's biodiesel compatibility with these generators holds potential and may require further research and funding. Leveraging its already existing biodiesel production factories within the country, a scaled-up waste recycling and biodiesel production plant may serve as a viable solution to the country's UAP problem.

However, an apprehended limitation of Biotech's fuel as per reports is that it has been tested with diesel, while private sedans (a significant polluter of the environment) mostly run on gas or octane/petrol. A portion of public transport that is diesel-run may be the only viable target for intervention yet, and thus petrol/octane compatibility needs to be assessed.

4.4.2 Air Bear

Air Bear has been a national success in Myanmar, and versions of it can even be seen in the streets of London (González, 2018)[37] informing people about the effects of UAP. Air Bear, in the context of

[37] A cute bear fights against air pollution in London with tech and data - Eastwind - Sep 2018 - https://eastwind.es/marketing/en/cute-bear-fights-against-air-pollution-in-london-with-tech-and-data/

Bangladesh, will provide a visual representation of air pollution, evident by the "bear" getting dirtier over time as it travels across different areas of the city.

Air Bear serves as an awareness mascot to promote the use of masks, reduce vehicular pressure on roads (hence less emissions) and adopt greener construction methods and thus impact all major identified sources of UAP. Therefore, Air Bear or Bangladeshi variations can serve as the mascot for a cost-effective awareness campaign to address UAP.

4.4.3 Aditya: India's first solar ferry

The solar ferry replacing traditional diesel-run ferries in Kerala, India, has been such an enormous success that the Kerala state government announced that it would replace all of its diesel-run ferries with solar-powered ones. Costing only one-third of a diesel run ferry over a 20 year lifespan, the solar ferry is inexpensive to run and produces close to zero emissions compared to its diesel-run counterpart.

The solar ferry is relevant in the Bangladeshi context due to the country's apparent abundance of sunlight coupled with its innumerable rivers and city river ports. Since most boats in Bangladesh run via an internal combustion engine, replacing these boats with solar-powered ones will help reduce emissions that are typical of fossil fuel powered engines.

4.4.4 Road Construction- Reducing Bitumen Usage by using plastic waste

Reducing bitumen use by using plastic waste during road construction can reduce air pollution. In Bangladesh, although some plastics are being recycled, it is not enough to curb all the plastics from going to the landfill. Dumped in landfills plastics wastes are burned along with other forms of waste. As we already have adopted 3R policy (Reduce, reuse and recycle) in the National Environmental Policy (2018) So, recycling the waste plastic to form pellets and beads to add to bitumen during road construction prevents the plastic from ending up in landfills.

As Bangladesh becomes increasingly developed with megastructures and cities being expanded, adopting relatively eco-friendly road construction methods to build the ever-expanding conflux of roads within cities is paramount in reducing UAP. And as a result of Bangladesh's relative abundance of plastic, recycling waste plastics can be a viable alternative to existing bitumen/asphalt through its high usage of plastic bags and bottles.

5 Key Study Insights

Throughout the course of the study, the assessment team conducted primary and secondary research to understand the global and local impact of air pollution, identify patterns and trends, map out potential knowledge and policy gaps, and field-level implementation dynamics. The findings were broadly categorized into the following: Knowledge, Attitude, and Perception (KAP) of the youth and communities, impact on child's wellbeing, trends of the global funding landscape, insights from global benchmarking, and reflection on top major pollution contributors in the Bangladeshi urban context.

At the *KAP of the youth and communities* level, the assessment team identified three key trends derived from an information gap and resulting in increased misinformation. At the community level, firstly, the invisibility of air pollution resulted in people associating its potential health impact with more visible or perceivable causations, e.g. people associating poor health with climate change. Secondly, there was a consistent attempt at disassociating from the problem, where it was observed that individuals were reluctant to accept that their actions may result in pollution. Finally, there is a perceived notion that the impact is disproportionate, where families belonging to the upper socioeconomic class were of the opinion that only families and individuals living in poorer housing facilities (slums or houses next to industries) were the only ones being affected.

The assessment team conducted FGDs, KIIs and other group sessions among various youth cohorts and community members and found the following insights:

Summarized Talking Points	Insights
Understanding and Awareness of Urban Air Pollution	Most participants demonstrated an elementary level of understanding regarding urban air pollution and stated that they were aware of the rapid deterioration of air quality and that it required immediate attention. **Key Observation**: Participants with medical conditions associated with breathing/lung function (e.g. Asthma) demonstrated greater knowledge about urban air pollution.
Sources of Urban Air Pollution	No participants were able to identify brick kilns as a major source of urban air pollution. Their identified sources involved improper garbage disposal, vehicular emissions and from road and building construction. Only a few identified industrial emissions as a source of Urban Air Pollution. **Key Observation:** Participants were notably vocal about the megaprojects (metro-rail, elevated expressway) and notified how

	they have often experienced breathing difficulties or had to wear masks (before covid-19) while near these construction sites.
Awareness of existing interventions	No participants were able to identify interventions that currently address Urban Air Pollution. **Key Observation**: Most participants expressed the desire to be part of interventions that help facilitate better living standards but noted the following: 1. When designing interventions that engage the community, participants stated that convenience of use/participation would be the key selling point 2. if the interventions require money- it must be cost effective 3. The interventions also must not intrude day-to-day activities (shouldn't have to go out of their way to participate)

Table 18: Key Observations

The group discussion sessions conducted with youth and community members revealed that the majority of them could not identify a few of the major contributors of the urban air pollution across their respective cities. A commonly perceived notion is that vehicular emission and industrial emission are the key pollution sources whereas in reality, according to the data gathered by the Department of Environment, *Brick kilns* are responsible for 58% of air pollution in the capital. Across few city corporations in the country where garbage landfills are filled, authorities often subscribe to open burning of the waste which is another key contributor to the air pollution problem. While most urban dwellers could identify industrial emissions, fugitive sources of pollution from these industries (emissions which escape to the atmosphere through windows, doors, vents, etc. of a factory, but not through a primary exhaust system) remained an alien concept to all. The most alarming concern is that very few participants could recognize indoor air pollution as a source of respiratory diseases for the children and adults alike whereas according to World Health Organization, every year approximately 50,000 people die in Bangladesh owing to indoor air pollution.

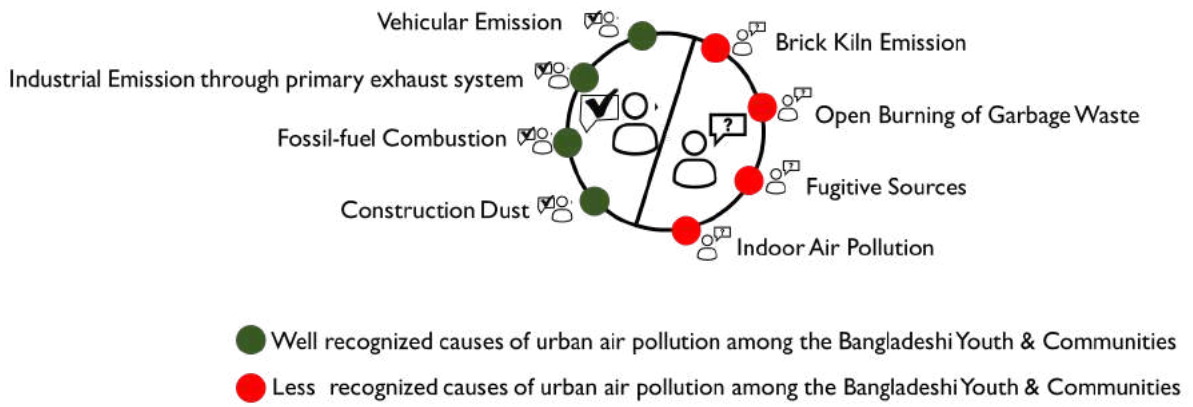


Fig 3: Mapping the well-recognized and less recognized causes of urban air pollution in Bangladesh

In line with the above, a number of physical and psychosocial impacts of urban air pollution were found to be absent in the average citizens' mind. While respiratory disease were mostly perceived to be connected with air pollution, long term consequences such as neurodevelopmental disorder of children, premature birth during pregnancy and other related negative health consequences were missing in the list of health impacts identified by the respondents.

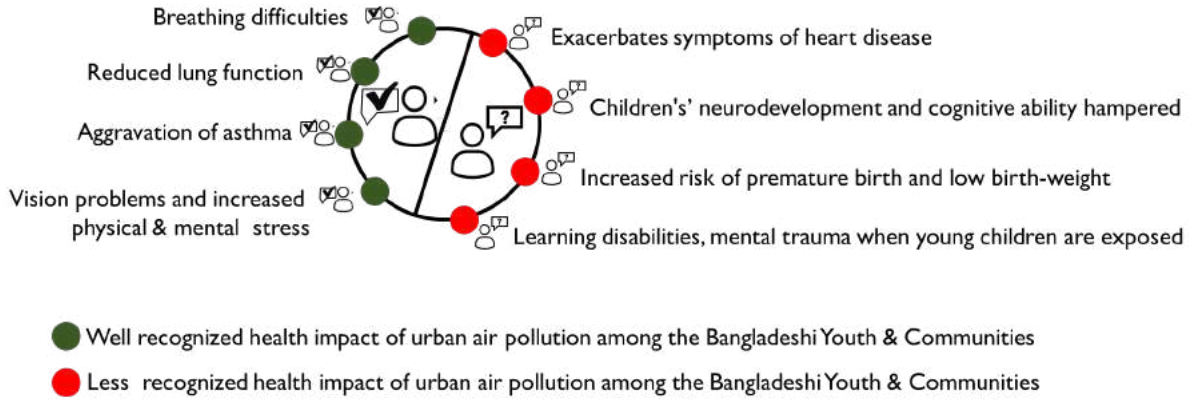


Fig 4: Perceived and less recognized health impact of urban air pollution

The assessment team further found that at the *child's well being* level, children were disproportionately more impacted by air pollution than adults. With every breath, children take in more air per unit of body weight than adults(more frequently, bigger breaths on a pound for pound basis). (Institute For Toxic Substances and Disease Registry, n.d.) By extension, when air is toxic, they take in more toxic air per unit of body weight than adults. Furthermore, the assessment team identified that health impact on children can be further translated to broader indirect economic impact in the long run. Poor health conditions in children result in time away from school and absence of participation in critical cognitive development activities. According to (World Health Organization, n.d.) more than 93 percent of all children under five currently are exposed to ambient air pollution above WHO guidelines.

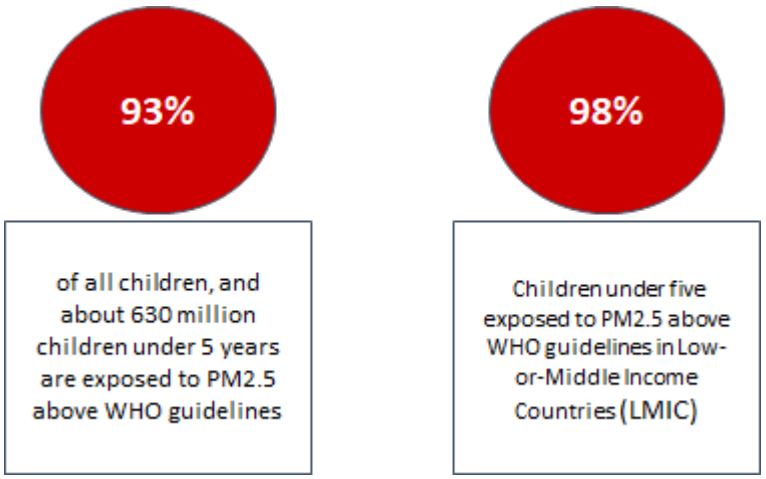


Fig 5: Stats regarding child pollution exposure (source: WHO)

Pregnant women are also particularly susceptible to air pollution, pregnant women when exposed to polluted air, are more likely to give birth prematurely, and have small, low birth-weight children. Air pollution also impacts neurodevelopment and cognitive ability and can trigger asthma, and childhood cancer.

At present, the urban areas, particularly Dhaka, are predominantly polluted by brick kiln emissions, vehicular emissions and from industrial and construction emissions. Brick Kilns account for a remarkable 58% of all particulate matter pollution in Dhaka whereas areas undergoing massive infrastructure projects and unplanned construction are also experiencing severe pollution. Improper handling of construction material and lack of overall supervision has only worsened the situation.

Ambient air quality	Air quality near mega project construction
200ug/m3* *ECR 1997 (2005 amended)	**Metro-rail and Dhaka Elevated Expressway Project construction** Mirpur: 1,137ug/m3 Agargaon: 1,111ug/m3

Source: New Age Bangladesh

According to the New Age Bangladesh, a national daily, the ambient air quality set by the Environment Conservation Rule was 200ug/m3 but areas (Mirpur & Agargaon) near the construction of the metro rail and the elevated expressway were found to be more than five times above the acceptable standard. Despite the Department of Environment fining the two projects in Nov 2019 for breaching air quality standards, the projects were found to be breaching air quality standards again 2 months after. The assessment team identifies gaps in knowledge, training and prudent monitoring as the main contributors to the problem.

Following a local context analysis, the team undertook *global benchmarking,* where the team analysed case studies (see section 3) and noted the following trends. Globally there has been a surge

in youth led innovative ideas that leverage technological advances to address air pollution, Furthermore, the study team also identified that historically, air quality management has been viewed as an environmental issue, often without consistent and direct engagement from health, energy, transportation, and other sectors that influence, or are influenced by, air quality. Finally, Engaging the health sector is a newer approach to addressing air quality. And the assessment team emphasizes that they must play a larger roles in promoting awareness of and building support for air quality improvement initiatives in Low-Middle Income Countries.

Finally, the assessment team looked into the *global funding landscape* to identify the following trends. According to a report by the Clean Air Fund, In 2019, over $1.4 billion in official development spending was disbursed to projects with the primary or secondary objective of improving air quality. This is less than 1% of total aid spending. This indicates that there is still a gap in prioritization of air quality improvement related funding.

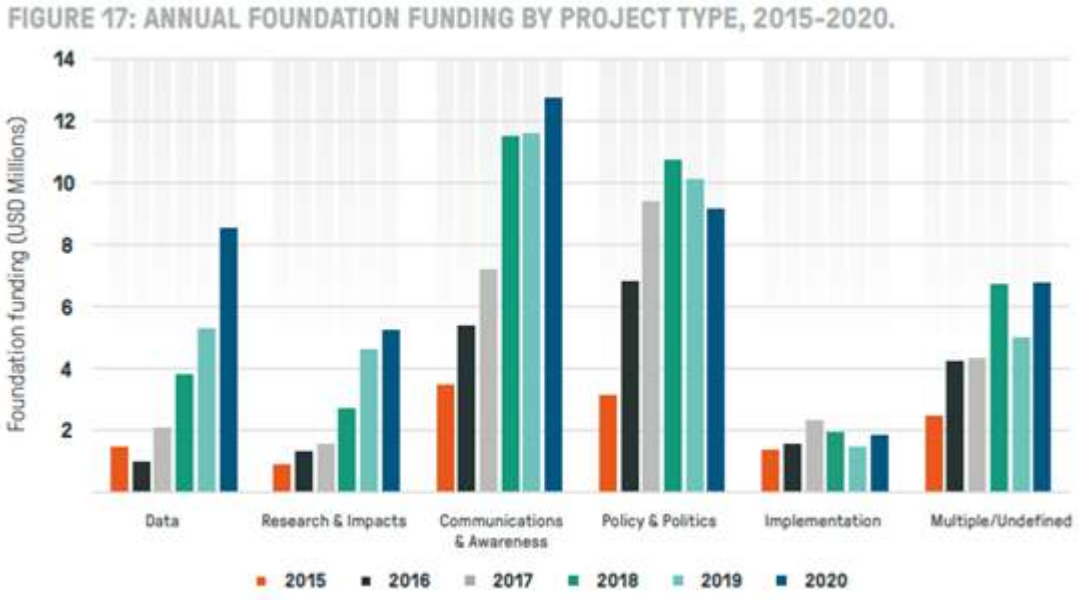


Fig 8: Funding Data (Source: Clean Air Fund)

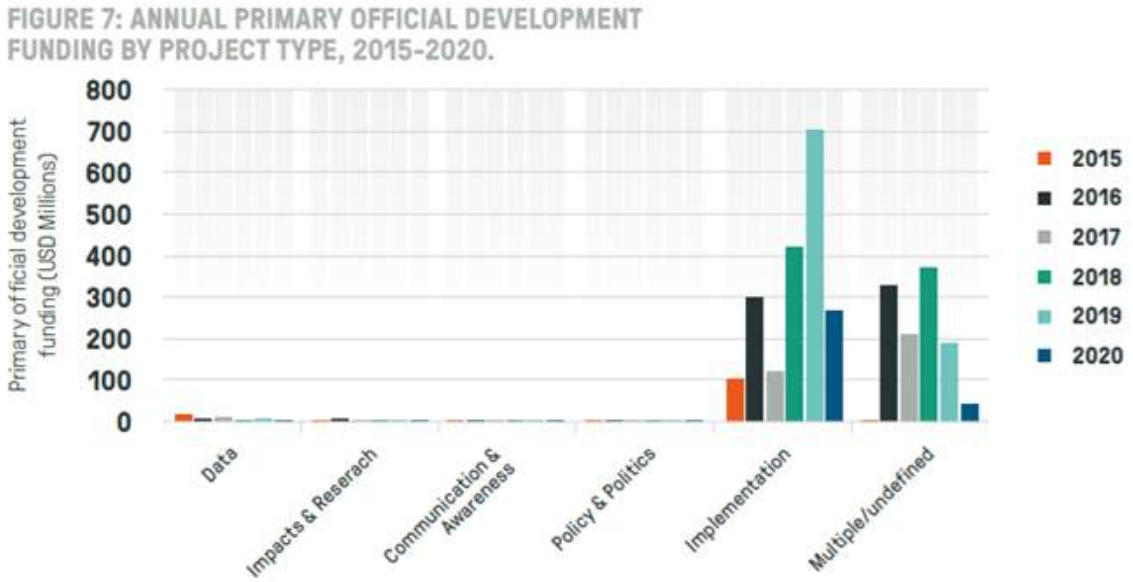


Fig 9: Funding Data (Source: Clean Air Fund)

The figures above demonstrate the official and foundation funding for project type. Funding from foundations was the highest when concerning awareness and communication, and policy projects whereas official fundings primarily focused on implementation or multipurpose projects. The assessment team identifies this funding trend as a guiding note for World Vision Bangladesh to use during the enactment phase of the intervention options identified in the following section.

6 Programmatic Intervention Options with Analysis

The purpose or expected outcome of these intervention options is to guide programs and activities where World Vision Bangladesh can engage directly in solutions with the aim to address urban air pollution. They are designed to indicate how the relevant and necessary resources, expertise and technical knowledge can be accumulated through engagements with relevant stakeholders. The intervention options target specific work areas that involve the urban air pollution ecosystem. They also focus on inclusion of segments or subsegments who may require additional assistance or focus to participate on the overall transition. These groups include, school age children, children in lower income households, urban poor, the informal labor force and low skilled workers.

The interventions were developed through a combination of 3 major sources.

- Innovation challenge:
  This source was tapped into to identify youth-driven intervention ideas aimed at addressing urban air pollution. These would have the added benefit of also reflecting the care views and

thought reflections of the youth of the nation, as well as injecting innovation into addressing air pollution.

- Global Benchmarking:
  This provided insights into global initiatives from different economies, geographic zones, cultural backgrounds, as well as technological advancements. Following this, applicable intervention ideas were filtered into the assessment phase to help ensure suitability to the Bangladesh Context.

- Expert Insights:
  This involved accumulation of experts in the field, from a pool of contributors which included, environmentalists, academicians, activities, representatives of government agencies, private sector actors and representatives of the general population.
  This had the added benefit of acquiring seasoned insights and intervention ideas developed by industry insiders, which hold high potency in addressing urban air pollution from the source as well as at the sites of affliction.

The interventions were assessed through a five tiered analysis framework which involved

- Technical Feasibility
- Financial Feasibility/Sustainability
- Technological Feasibility
- Impact Potential (impact on urban air pollution/air quality)
- Community Engagement Potential

Following the assessment through this five tiered framework, the intervention options with the highest potential were added to the intervention options framework discussed in this section.

Note:
A core component of the study was to identify high potential ideas generated by the youth of the nation. This was done through an innovation challenge open to all youth in Bangladesh. However, once the ideas were collected, it was identified during the assessment phase that most of the ideas submitted did not fare well in terms of technical feasibility, impact potential and community engagement potential, especially when compared to intervention options from the other two sources. As such, it would be prudent to develop these ideas further to gain more impact and community engagement potential before they are considered for interventions. Following this, these ideas were augmented into one intervention option aimed at developing them further (ProgApp1).

6.1 Awareness

This refers to intervention types aimed at increasing overall information available to individuals to promote informed decision making. Awareness interventions can include campaigns, community workshops, community driven activities as well as informative programs aimed at specific audiences.

Aw1: Intervention Option	Develop and implement a social awareness campaign that leverages social media platforms and mass media to increase awareness regarding green lifestyle practices among youth and adolescent cohorts
Core concept	Leverages social media platforms and mass media to increase awareness of green lifestyle practices
Intervention Area:	Social media, youth, lifestyle, adolescents
Target Audience and Collaborators	Children, School-going Children, Youth and Adolescents, Parents of young children, Content Creators, Television Channels, ICT ministry
Rationale	Context Green Lifestyle and Behavioral Shifts Adaptation of a green lifestyle is really important in terms of living a healthy life and reducing the pollution from our environment. Though the green lifestyle movement may not make remarkable changes overnight. But, these small steps to preserve our planet Earth may reap big rewards in future. To drive changes that have lasting effects on the future, there is a need to enable youth driven changes. Awareness campaigns play a significant role in ensuring that individuals make informed decisions. According to a study, cartoons are particularly attractive to children and instill in them positive and negative behavioral changes (Hassan & Daniyal, 2013).[38] Furthermore, another study indicates that cartoons depicting socially responsible behaviour will trigger socially responsible behaviour among children (Q. et al., 2021).[39] Therefore, awareness campaigns to trigger behavioral changes in adolescent groups can leverage the impact of cartoons. Engagement of Children and Youth

[38] Hassan, Ali and Daniyal, Muhammad, Cartoon Network and Its Impact on Behavior of School Going Children: A Case Study of Bahawalpur, Pakistan (March 15, 2013) - https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2241824

[39] Zhang Q, Duan Z, Xiang D, Yu Y, Tian J. The Effects of Prosocial Cartoon Examples on Children's Donating Behavior. Psychol Res Behav Manag. 2021;14:1257-1268 https://doi.org/10.2147/PRBM.S315068

	Given that the aim of the campaign would involve two major classes of audiences with limited overlap of preferred mediums, to ensure maximum reach and widespread information dispersion, it is also important to identify platforms (delivery mechanism) that are compatible with the different target cohorts. Utilizing Focused Mediums for younger audiences There are already well-practiced channels of reaching younger audiences which usually involve broadcasting on television, integration into primary school curriculums, and after school programs among others. It is possible to develop programs which address urban air pollution issues and how to tackle them by producing programs of similar kinds or even through integration into existing programs, such as school debates and school based art competitions (extra curricular activities), scouts and red crescent youth (after school programs), cartoons and specially episodes in children's TV shows (Moner Kotha, Sisimpur). Recently there has also been an uptick of children's content throughout online entertainment content websites (such as YouTube) following an increase in young viewers. Usually, they access this content through their parent's accounts since children are not yet allowed to legally have accounts. But children-focused content can also be directed towards social media accounts of parents, who would then present the content to their children under their supervision. Utilizing Social Media Platforms for Youth Furthermore, Bangladesh has seen an exceptional growth in the number of social media users in the past years. In Covid-19 the number of internet users had seen an exponential growth. The total number of internet users in the country is 47.61 million, in January 2021. This number increased by 7.7 million (+19%) between 2020 and 2021. Internet penetration in Bangladesh stood at 28.8% in January 2021 (KEMP, 2021).[40] There were 45.5 million Facebook users in Bangladesh in January 2021, which accounted for 26.4% of its entire population (NapoleonCat, 2021).[41] To promote widespread adoption of green best practices, there is a dire need to leverage the exponential reach capabilities associated with social media platforms, especially Facebook alongside traditional mass media. Therefore, to

[40] DIGITAL 2021: BANGLADESH - DataReportal : Global Digital Insights - Feb 2021 - https://datareportal.com/reports/digital-2021-bangladesh

[41] Facebook users in Bangladesh - Napoleoncat - January 2021 - https://napoleoncat.com/stats/facebook-users-in-bangladesh/2021/01

	appeal to the youth cohort, leveraging social media platforms may yield greater impact. Engagement Steps - Conduct a social awareness campaign targeting youth and adolescent groups by leveraging mediums with highest respective exposure to enable lifestyle and behavioural changes - Create content for social media (youtube, facebook, instagram) to engage youth by leveraging social media impact of public figures and social media influencers - Create a series of animated content designed for children depicting day-to-day environmentally positive practices by partnering up with animators, content creators and environmentalists - Facilitate programs addressing urban air pollution awareness aimed at younger audiences through school based medium - Focus on online and offline programs and content to ensure inclusion of disadvantaged children (online only programs will likely not reach children in low income households, due to lack of internet access) Following successful piloting, such campaigns can be scaled up in three major ways. First, it can be scaled up by expanding the target group to also include children's immediate influencers- elder siblings, school club/sports club/literature club seniors. Secondly, the campaign can be expanded geographically into peri-urban areas for offline school based events. Thirdly, the campaign can be scaled up by expanding delivery mediums e.g. tv channels, roadshows. Limitation Relevant, quality and eye catchy contents rule on social media. Sometimes, essential things get buried over the hive of trendy posts. So, quality content making should be the first priority, but getting public attention depends on lots of other factors. The social media campaign is undoubtedly the best way to get the attention of mass people. Furthermore, it is also important that the content created for the awareness campaign are promoted effectively to relevant target groups. Awareness campaigns typically have comparatively low impact on instant but reserve the potential to create strong impact in the long run. Short term campaigns can generally be evaluated using baseline-endline evaluation of the

	beneficiary cohort. For long run campaigns, the evaluations can also include other stakeholders.
Aw2: Intervention Option	Initiate a public-private awareness campaign by partnering up with relevant government departments to increase demand-side awareness for alternative bricks
Core concept	Increase awareness about the benefits of using non-fired bricks
Intervention Area	Alternative bricks, demand generation
Target Audience and Collaborators	Construction workers, low skilled workers, urban poor, low income households, DOE, MoInd, RAJUK
Rationale	Context: While moving away from traditional bricks into block brick alternatives, that do not have to undergo the highly polluting burning process, have been legally backed by the Brick Manufacturing and Kiln Installation Act, 2013 (Amended 2019), there is still the need to generate demand-side awareness regarding alternative bricks to drive a demand induced market transformation. According to Bangladesh's Department of Environment, emissions from brick kilns contributed to 60 percent of the particulate pollution in Dhaka while representing only 1 percent of the country's GDP (Price, 2018).[42] While the GoB is currently planning to phase out the use of traditional brick gradually over the 2019-2025 time period, there is a dire need to increase awareness among demand side players about the cost effectiveness and relatively low environmental impact of alternative bricks(non-fired bricks). According to EU SwitchAsia data, using alternative bricks result in 25% less iron and concrete use and an overall reduction in cost by 20-25%. Furthermore, EU SwitchAsia data further states that fewer alternative bricks are required during construction compared to traditional red bricks. Therefore, awareness campaigns to reduce legacy beliefs dominating purchase behavior will aid in a demand driven market transformation with a significant reduction in emissions. Engagement Steps

[42] Bangladesh's Air Pollution Problem Grows, Brick by Brick - Pulitzer Center - OCTOBER 22, 2018 -https://pulitzercenter.org/stories/bangladeshs-air-pollution-problem-grows-brick-brick

	- Conduct an awareness campaign by partnering up with DOE, MoInd, RAJUK and relevant stakeholders to increase user level awareness regarding the benefits of alternative bricks. - Arrange seminars, focus group discussion with relevant stakeholders to spread awareness of not using traditional redbricks and showcase the alternative block bricks. - Inform producers and entrepreneurs about government incentives for green manufacturing to promote and highlight potential investment opportunities in the sector - Facilitate Capacity Development of local labor force in the use of the newer building materials (including processing, material composition, mixtures and curing, etc.) Limitation The construction industry is somewhat nebulous in urban areas in Bangladesh, primarily employing independent and usually unregistered construction workers. These workers follow a generally understood practice of 'arriving at the pick up point' and then being 'hired for the day' by construction contractors. Moreover, given that they are day laborers, for any of them, missing a day of work means missing a day's paycheque. As such there is generally a reluctance in attending training programs, especially for skills and construction methods that they have not seen a demand for in the market. And without available skills, construction contractors will not take on jobs involving newer green materials, thus making the problem circular. Usually, in these instances the process begins with the government mandating such requirements for construction in government projects and then the demand for the skill and this demand for green construction materials (including green bricks) kicks off.

Table 19:Awareness Intervention Options

6.2 Programmatic Approach

These recommendations refer to intervention types that constitute undertaking a set of activities by the implementing party towards a long-term goal. This can be either through initiating programs with a set objective, i.e. support programs for different stakeholders, facilitating training and capacity development for the local residents and labor force, among other things.

ProgApp1: Intervention Option	Organize a Project/Business Idea Development program targeting innovative ideas from the youth aimed at addressing urban air pollution, turning them into functional and sustainable startups, beginning with the top ideas from the Urbania - World Vision Air Solutions Challenge.
Core concept	Host an incubator to develop innovative UAP solution ideas
Intervention Area	Accelerator, Incubator, Functional Solution Development
Potential Collaborations	Bangladesh Angels, Angel Investment, A2I, GP Accelerator, Innovators, Startups, Investor, Young Entrepreneurs
Rationale	Context: Current status in urban air pollution needs innovation from the youth. And then you need support in developing effective and sustainable solution models. WVB has already taken the first step in this process through Urbania, an idea competition aimed at the youth. And some interesting ideas have already been identified. In order to speed up the implementation of these ideas and a proven method of achieving this is to engage incubators and accelerator programs. Incubation and Acceleration Idea Incubators are specialized programs aimed at taking in base level ideas and forming them into executable field ready projects/businesses. The core of this process involves developing the logical steps of achieving the goals of the idea in a coherent way, especially in terms of - Process Planning, - Logistics Management - Timeline and Operational Scheduling - Financial Management protocols - Revenue Models and Profit Orientation - Legal Structuring and Licensing Once an idea goes through an incubation process, it will be in a position to launch operations (field ready).

	Acceleration is a separate process that is applied to projects/business currently in operation (as opposed to the idea themselves). This process involves assessing the current status of a business, identifying major shortcomings and key opportunities, and developing plans to address the weaknesses and capitalizing on the advantages. These programs help young entrepreneurs to learn about business basics, networking opportunities, connections to strategic partners, access to angel investors or venture capitals, technology commercialization assistance, intellectual property management and legal counsel, etc. Startups, subjected to the rigorous training and knowledge gathering regime in accelerators, are more likely to make informed market decisions and display adequate knowledge of market dynamics. Engagement Steps: - Collaborate with reputed currently operating incubators and accelerators to develop a series of programs focused primarily on startups that provide UAP solutions. - Conduct workshops with startup development experts, academicians and relevant GoB experts to develop a work vision accelerator program for startups that are aligned with WVB's long term goals. - Connect with potential angel investors and seed fund providers to benchmark key startup performance indicators that are desirable for investors to ensure that the startups are "investment ready". Limitations While accelerators play a crucial role in developing a startup's internal infrastructure, these only pay dividends in the long run. A startup accelerator program developed by World Vision Bangladesh for the winning ideas from the innovation challenge will likely take time to yield visible results in addressing urban air pollution. Typically, incubators require high startup specialist involvement and little community involvement and the success of the incubators themselves may depend on knowledge sharing and technical partnerships with existing platforms to leverage their market experience and access to investors and green financing institutions. Therefore, ideas incubated or startups accelerated by WVB may either need to have Two-sided Marketplace Models (platforms that connect individuals or parties on the opposite sides of a transactions) or tweaked into Two-sided Marketplace Models to allow for maximum community involvement.

	A point about how the solutions to come out of this type of intervention will get low scores in terms of 'Community-based Approach.' And the most potential community engagement (beyond being customers) will come from ideas which will need to be adjusted into Two-sided Marketplace Models (the Uber model).
ProgApp2: Intervention Option	Provide technical support to improve the Electric Vehicles (EV) Infrastructure including capacity development to promote usage of Electric and Hybrid vehicles.
Core concept	Promote Hybrid and Electric Vehicles usage through technology transfer support and capacity development support
Intervention Area	Electric Vehicle, Hybrid Vehicle, Capacity Development
Potential Collaborations	MoInd, BRTA, Roads and Highways Department (Ministry of Road Transport and Bridges), Bangladesh Automobile Industries Limited, Automobile Manufacturers and Assemblers, Automotive Technicians
Rationale	Context Emission from reconditioned automobiles and improvement of EV infrastructure Traditional automotive vehicles are propelled by an internal combustion engine that typically runs on fossil fuel (i.e. petrol, diesel). When these engines run, they produce gaseous emissions such as hydrocarbons, nitrogen oxide and sulfur oxide that can cause breathing disorders among other diseases (Department of Environmental Conservation, 2021).[43] Furthermore, when these engines run, a small amount of fuel exits through the exhaust unburnt, which can then mix with dust and existing particulate and gaseous matter to form complex hydrocarbon compounds that may pose a significant health burden on the community. Causes of excessing emissions from cars According to environmentalists, academicians, and activists, reconditioned (internal combustion engine) vehicles arrive in the country when near or after the end of their efficient lives and therefore these reconditioned vehicles, running with unoptimized and inefficient engines, are unable to fully utilize their fuel. Furthermore, when these reconditioned vehicles run, their engines can show signs of aging with crucial engine elements such as the fuel injection system, air filter, exhaust manifold failing to run efficiently. These

[43] Controlling Air Pollution from Motor Vehicles - Department of Environmental Conservation - https://www.dec.ny.gov/chemical/8394.html

	vehicles, as a result, release black smoke from the exhaust and burn too much fuel (San Joaquin Valley Air Pollution Control district, n.d.).[44] Balancing the need for cars with health risks This black smoke, when released, contains carbon micro particles of a diameter less than 2.5 micrometer which remain suspended in the air. particles are also accompanied by other harmful pollutants such as sulfur dioxide and polycyclic aromatic hydrocarbons that are known to absorb other pollutants to form complex compounds. When inhaled, these particles can reach our lungs and have devastating health effects including and not limited to lung diseases (Futura sciences, n.d.).[45] Import of Older (less effective) Fossil Fuel Cars At present, the country's car importers are required to only import reconditioned cars aged 5 years or less (Ministry of Commerce Government of the People's Republic of Bangladesh, 2018).[46] However, while limitations are present on the import of reconditioned vehicles, these vehicles are often resold multiple times in the second hand market and at present, 95% of all cars in the country presently in use are either reconditioned or used (LightCastle Analytics Wing, 2020).[47] Therefore, vehicular emissions particularly from these vehicles stipulate a serious cause for concern. Electric Vehicle Policy for Bangladesh According to informants currently engaged in policy drafting in the Ministry of Industries, there are certain policies currently in the works that prioritize Electric Vehicles - leveraging the country's current excess electricity generating capacity to help build the infrastructure, i.e. charging stations, state of the art parts availability, in-house assembling of electric vehicles (Chakma, 2019) (BAIL[48]) among others.

[44] Let's clear the air - San Joaquin Valley Air Pollution Control district - https://www.valleyair.org/newsed/smokingcars/smoking.vehicles.pdf

[45] Black smoke - Futura sciences - http://www.futura-sciences.us/dico/d/sustainable-development-black-smoke-50000777/

[46]https://mincom.portal.gov.bd/sites/default/files/files/mincom.portal.gov.bd/page/e177ee18_f389_4f9e_a40c_57435cfac5b2/Import%20Policy.pdf

[47] Bangladesh Automotive Industry: A Roadmap to the Future - LightCastle Analytics Wing - June 29, 2020 - https://databd.co/stories/bangladesh-automotive-industry-a-roadmap-to-the-future-12759

[48] Local firm to set up $200m plant to make electric vehicle - The Daily Star - 2019 - https://www.thedailystar.net/business/news/local-firm-set-200m-plant-make-electric-vehicle-1776208

	Electric Vehicle Infrastructure
	Since vehicular emissions are a major source of UAP, providing technical support to help in developing the EV infrastructure will create downward pressure on the demand for reconditioned vehicles. A lower demand for these reconditioned vehicles will significantly impact UAP as a result of lower vehicular emissions. This infrastructure is already being planned as part of the policy development. However, the process will need to move much faster given that fossil fuel cars are one of the major sources of urban air pollution at the moment.
	
	Additionally, rapid technology transfers can help inform members of the automotive industry towards making more environmentally friendly decisions. And a focused approach at capacity development would promote inclusion of various underserved segments of the population (members of the urban poor such as standalone automotive technicians and last mile parts retailers)
	
	Engagement Steps:
	- Conduct workshops with industry experts, academicians and environmentalists to provide recommendations on major areas which need improvements
	- Collaborate with academicians to strengthen the knowledge base in terms of adaptable technology to address vehicular emissions
	- Collaborate with global industry representatives to identify current trends in the automobile industry and engage in knowledge sharing to provide recommendations to GoB on the "how-tos" of strengthening the local EV and hybrid infrastructure
	- Engage in long term partnerships with relevant GoB departments to play an active role in policymaking
	- Facilitate capacity building of local workforce in the following skill types:
	  - Production and Assembly of EV
	  - Construction of EV charging stations
	  - EV Maintenance and Repair (including independent standalone technicians)
	  - EV Charging Station Operations and Maintenance
	
	Limitations
	Attempts at limiting the use of reconditioned vehicles may face initial resistance as a result of it being a high revenue source (taxes) for the GoB. Furthermore, the majority of the automobile businesses in the country trade in reconditioned vehicles, and therefore significant

	resistance is expected. Furthermore, technical support may also have to be accompanied by policy support and government incentives in order to yield long term impact and EV industry resilience. However, environmentalists and academicians argue that reducing vehicular emissions and the subsequent health burden from inhaling these emissions is of utmost priority, and therefore, require immediate government attention. Furthermore, incentives aimed at developing the domestic EV infrastructure will encourage investments and help build a robust environment that can provide competitive prices for the citizens with fewer emissions compared to their traditional counterparts. Therefore, advocating this course of action will have a significant impact on the current and future status of UAP in the country.

Table 20: Programmatic Approach Intervention options

6.3 Technical Assistance

This involves undertaking a series of knowledge and technical resource development through exploration and commissioning of studies, in focused areas, aiming to acquire expertise and guidelines to promote effective development of infrastructure, policies and cultural and commercial practices. This process will involve engaging in dialogue with the government to introduce new policies, enforce existing policies, inform upcoming policies, and amend present policies to reflect current and future circumstances.

TechAssist1: Intervention Option	Commission the development of an app that gives the public access to live DoE Air Quality Data as well as the platform for public participation in community waste management practices.
Core concept	Develop a real time area-wise air quality index and community-driven platform for localized waste management
Intervention Area	Air Quality Data, Waste management
Potential Collaborations	DoE, DNCC, DSCC, App Developers
Rationale	Context: Air pollution is a national scale problem and at any given moment, it is very difficult to have a large-scale impact on this problem. It is important to approach this with a continuous series of small steps by a large number of concerned participants. In recent times, the citizens of the world, especially people from areas with high volumes of air pollution are becoming more concerned and also, more active in trying to address these issues. These attempts are usually independent and uncoordinated. This of course means that large scale impact becomes improbable. However, their participation and subsequent impact can be improved through coordinated efforts and through access to better information. There have been initiatives in different parts of the world aimed at just that. One example is a publicly available app which allows for people to get access to up to date data on air quality in their locality. Aside from this, these apps also allow for everyday citizens to engage their local government to address air pollution related issues in their area. Such apps can also be used as a platform to organize community-based activities allowing for people to collaborate in activities to address air pollution. Engagement Steps: - Commission an interactive app with an easy user interface for use by citizens in Bangladesh

	- The app should be associated (to relevant degrees) to national bodies working in air pollution. The app can be centrally managed by these national bodies and regularly provide people updates on air quality in their area - The app should also have a mechanism for everyday citizens to anonymously report various pollutants, emission sources, unauthorized waste sites, improper waste management to their local authorities who will be in a position to address. - The app can also have an interactive feature which allows for members of specific communities to learn about activities to address air pollution in their area and how they can participate - The app can also have social features where citizens post their green activities and share ideas and green lifestyle tips with others in their area. Air Quality Data Air Quality is still a confusing and obscure concept. While the issue is rapidly gaining popularity, the finer points of Air Quality Data is still not well known to most people. Bringing information and data to people and putting it on the forefront has multiple benefits. - It informs people on the reality of their situation - It encourages people to take action - It makes information accessible to people who do want to take initiative and informs their actions as well - It can also be useful for their everyday lifestyle decisions Community Participation in Local Waste Management Air pollution comes from a wide range of sources. And not all of it comes from chimneys of factories far away. Improper waste management, burning trash/leaves/plastics are all sources of air pollution that happen right around us. And while usually a lot of it is usually managed by the local authorities, the people who are responsible can't always be aware of every instance of impropriety in terms of waste management or other such local sources of air pollution. However, usually these things are sooner seen by local residents, and this presents a chance for people to let their local authority know so that action can be taken. Limitation The concept of advancement through mass data dissemination hinges on two major factors, the Supply of Accurate Data and the Capacity of the Audience.

	In the instance of *Supply of Accurate Data*, the data will have to be sourced from reputed sources who can provide consistent and accurate data. Generally, these come from government run institutions who have a mandate in teaching air quality and the status of the environment for the public interest. This step also depends on consistent supply of data which depends on close coordination between the data source and the dissemination team. But this can be remedied by setting achievable goals in terms of dissemination schedules. One common mistake is over-promising and trying to send in too much data too fast. Instead, a good starting point would be to set daily/weekly/monthly data dissemination schedules and advance the schedule as the technology advances. In the case of *Audience Capacity*, it is important to remember that the goal here is to inform the public and not force them into action. Given time, many enthusiasts will take it upon themselves to act based on the data available to them. Not everyone will be equipped with the knowledge or practical resources to engage in solutions from day one. But as people continue to have more and more access to the relevant data, those who are already prepared to take initiatives will be able to inform their actions better. And those who are not yet prepared, will have the chance to identify scopes for intervention through this data.
TechAssist2: Intervention Option	Engage in Policy advocacy to formulate industrial emissions guidelines as per global best practices and ensure the implementation of eco-friendly green technology in terms of brick manufacturing.
Core concept	Create guidelines to control emissions from industries and identify green manufacturing practices
Intervention Area	Industrial Emissions, Brick Kilns
Potential Collaborations	MoInd, DOE, Brick Manufacturers,
Rationale	Context Industrial Emissions policy Industrial emission is one of the three major sources of urban air pollution. The Bangladesh Perspective Plan 2041 outlines potential policies such as taxing emissions from industries, and the Department of Environment is also working on a draft industrial emissions guideline which is currently under review. Although the problem has been acknowledged, academicians, environmentalists,

	and activists still stress that there is much to be done to address this issue. One of the major sources of industrial emissions that result in severe air pollution are traditional brick kilns. In Bangladesh, there are some 7000 kilns with high demand for bricks due to the growth of the construction industry amid an economic and infrastructure boom (Price, 2018).[49] During the dry season, according to environmentalists, the absence of moisture in the air enables dust and particulate matter to float freely in the air. While emissions from vehicles and disposal of waste via combustion are significant contributors, according to Bangladesh's Department of Environment (DOE), emissions from brick kilns contribute to 60 percent of the particulate pollution in Dhaka while representing only 1 percent of the GDP (Price, 2018).[50] Thus emissions from brick kilns, particularly in winter, form "fog-like" clouds over urban areas and can be considered a severe health hazard to residents and the urban ecosystem. There are policies, such as the Brick Manufacturing and Kiln Installation Act, 2013 (Amended in 2019) that makes it mandatory to use block bricks. The government has also issued a gazette notification in November 2019 which phases the targets of reduction of use of clay-fired bricks over the period of 2019 to 2025, except for the construction of the base/sub-base of high-ways. While brick manufacturing is the biggest contributor (60 percent) to air pollution in urban areas, other industries such as metal and cement production also have significant negative externalities. Even though issues with air quality are included in the Environment Conservation Act 1995 and the Environment Conservation Rules 1997, there is no stand-alone act currently dealing with deterioration of air quality as a result of industrial emissions. Engagement Steps: - Conduct policy advocacy programs in initiate the discussions on the much needed monitoring of the policies currently in force

[49] Bangladesh's Air Pollution Problem Grows, Brick by Brick - Pulitzer center- OCTOBER 22, 2018 - https://pulitzercenter.org/stories/bangladeshs-air-pollution-problem-grows-brick-brick

[50] Bangladesh's Air Pollution Problem Grows, Brick by Brick - P ulitzer center- OCTOBER 22, 2018 - https://pulitzercenter.org/stories/bangladeshs-air-pollution-problem-grows-brick-brick

	- Conduct workshops with industry experts, academicians and environmentalists to provide recommendations on major areas which need improvements - Collaborate with academicians to strengthen the knowledge base in terms of adaptable technology to address emissions - Collaborate with global industry representatives to explore potential policy suggestions which would address specific components of the industrial process (i.e. the material mixture used, the baking process, the fuel used, etc.) and encourage the seeking of environmentally friendlier alternatives through policies and taxation. Limitations Interventions aimed at limiting or regulating industrial emissions through regulations will potentially incur monitoring costs at the producer level and may be met with resistance. According to an unnamed informant from an industry association, Bangladesh's emission levels compared to other countries is relatively insignificant and therefore does not require immediate interventions and a significant amount of our pollution comes from across the borders. The informant may serve as a representative of the general sentiment among producers and manufacturers regarding any monitoring and regulations regarding Urban Air Pollution. However, environmentalists and academicians argue that the health burden as a result of inhaling emissions from industries and brick kiln manufacturers is of paramount priority, and therefore, requires immediate government attention. While producer level resistance will be a general constraint, it is also important that the DoE and other relevant authorities are provided with the technical resources required to conduct prudent monitoring.
TechAssist3: Intervention Option	Commission/Conduct a study that outlines global environmentally sustainable construction best practices to formulate a set of guidelines to recommend to relevant government department as part of policy advocacy
Core concept	Commission Study to identify Global Best Practices for building and road construction for policy development
Intervention Area	Understanding and replicating Global Best Practices

Potential Collaborations	BRTA, Roads and Highways (MoRTB), RAJUK, National Housing Authority, Public Works Department (Ministry of Housing and Public Works), DNCC, DSCC, DoE
Rationale	Context: Air Pollution from Construction Work According to the ESDO study, conducted in both rural and urban areas, construction materials are the leading cause of outdoor air pollution, producing 38% of all outdoor air pollutants (ESDO, 2020).[51] Population growth in our country is increasing day by day, and the increasing population generates more demand for new buildings and roads. These have the effect of increasing the amount of particulate matter (from construction dust), as well as bitumen from the asphalt used in road construction. Dhaka has seen a significant increase in particulate matter and consequent decrease in air quality since the construction of different roads and highway projects such as BRT, Metrorail, flyovers etc. Taking proper measures to keep the environment clean and ensuring safety during road and building construction is essential. Due to a lack of awareness and negligence from the relevant stakeholders, there has been little progress in solving this problem. In addition to this, absence of newer relevant policies and poor enforcement of existing policies to regulate construction pollution has further hindered progress. Road Construction According to environmentalists, notable deterioration in air quality was found due to the expansion of road construction in urban areas. Dust is an almost inevitable consequence of roadwork. Gravel and crushed gravel and hard rock aggregates mostly contain a proportion of fine aggregate, and if the material is dry, a fairly heavy dust cloud may form as a consequence of environmental forces, e.g. wind. Traffic movements on under-construction roads inevitably spread dust on the surrounding. This resulting dust disturbs people who are using the roads, local people, and the environment. Moreover, this traffic movement also diminishes the efficiency of road construction to some extent. This resulted in the construction cost being much higher than usual. Sometimes, due to system failure or incautiousness of the workers, an accident occurs at the construction sites. Building Construction

[51] Dhaka 4th Polluted City Globally- ESDO - https://esdo.org/dhaka-4th-polluted-city-globally-2/

	During the construction of a building, huge amounts of dust from the site tends to enter into the adjoining spaces and atmosphere. Sometimes there are accidental falls of debris/pieces which fall on the people who may be standing underneath or might be passing from the nearby walkways. Open construction buildings pose this kind of problem which is harmful to the air and surrounding vicinity. When it comes to building construction, the traditional methods have a lot of underlying negative effects on the environment and the health of dwellers. In traditional building construction, things like renewable, bio-sourced, and recyclable materials, and the use of renewable energies (geothermal, aerothermal, solar, wood), and the preservation of resources (energy and water efficiency, better insulation) (Solar Impulse Foundation, n.d.)[52] are not implemented at all. This creates the absence of sustainability which would have benefited the environment. In Bangladesh's densely populated landscape, this kind of unsustainable and harmful practice has long-term consequences as well. Mega Projects The GoB is currently undertaking major development initiatives including Dhaka Elevated Expressway and MetroRail projects. These major construction projects have repeatedly been identified by the DoE as sources of air pollution (Akhter, 2020).[53] While the ambient air quality standard as per the Environmental Conservation Rules, 1997 (amendment 2005) is also 200ug/m3, the DoE have found AQI scores of 1,137ug/m3 and 1,111ug/m3 respectively at the Mirpur-10 and Agargaon intersections along the Metro Rail project route (Akhter, 2020).[54] However, project coordinators stated that all preventive measures were taken in the project areas to prevent air pollution (Akhter, 2020).[55] Therefore, it can be inferred that stronger monitoring may be required of existing policies. Engagement Steps: - Commission a study that outlines global and environmentally sustainable construction best practices to formulate a set of

[52] GREEN BUILDING How to shape the future of construction? - Solar Impulse Foundation - https://solarimpulse.com/green-building-solutions

[53] DoE finds severe air pollution at sites - New Age Bangladesh - Feb 2020 - https://www.newagebd.net/article/98197/doe-finds-severe-air-pollution-at-sites

[54] DoE finds severe air pollution at sites - New Age Bangladesh - Feb 2020 - https://www.newagebd.net/article/98197/doe-finds-severe-air-pollution-at-sites

[55] DoE finds severe air pollution at sites - New Age Bangladesh - Feb 2020 - https://www.newagebd.net/article/98197/doe-finds-severe-air-pollution-at-sites

	guidelines to recommend to relevant government departments - Organize validation workshops with GoB officials from BRTA, Roads and Highways (MoRTB), RAJUK, National Housing Authority, Public Works Department (Ministry of Housing and Public Works), DNCC, DSCC, DoE. to validate the findings. - Engage in potential partnerships with relevant GoB departments to formulate potential policy interventions that outlines global environmentally sustainable construction - Collaborate with academicians to strengthen the knowledge base and identify adoptable global best practices for local use. - Collaborate with global industry representatives to explore potential policy suggestions which have been successfully implemented and identify global best cases of sustainable construction policies. - Conduct policy advocacy programs to initiate the discussions on the formulation of green construction guidelines - Facilitate the development of specific parameters concerning the construction process including definitions of violations of the parameters and associated consequences - Promote focused enforcement policies including rapid processing of sentencing for violations Limitation The major issue with most policy regarding adoption of practices is the reluctance from the involved parties. One of the major causes of pollution from construction is the direct negligence of the offending parties and the enforcement limitations of the authorities involved. For this purpose, clearly defined violations and consequences are necessary for proper enforcement. But it would also prove beneficial if a pull strategy was also engaged where the parties involved in construction were also duly informed of potential benefits of adopting such best practices, especially in places concerning their personal financial gain (for example, better maintenance of their construction material could reduce loss of said material through air pollution and reduce costs.)
TechAssist4: Intervention Option	Commission/Conduct a study on Urban biodiversity - to increase overall available knowledge on the subject matter in order to identify features in the urban ecosystem crucial for addressing UAP and engage in subsequent policy advocacy

Core concept	Conduct study to increase stakeholder awareness regarding preserving and promoting urban biodiversity and partake in policy advocacy
Intervention Area:	Urban Ecosystem Development
Potential Collaborations	Rajuk, DNCC, DSCC, DoE, CDA, KDA
Rationale	Context: Urban Biodiversity Urban biodiversity refers to the variety and variability among living organisms found in a city and the ecological systems in which they occur. Overall, urban biodiversity responds to a combination of biogeographic and anthropogenic (human-made pollution) factors, with a strong influence of the latter (J.A. et al., 2014).[56] In general, urban biodiversity refers to the collection of living organisms in and around cities and urban areas, and includes the relevant habitats (water bodies, vegetation, forestation, etc.). Urban biodiversity has a strong impact on the environment, including in their contributions to maintaining the stability of the local environment. Water Bodies promote humidity in dry seasons through evaporation, small organisms contribute to processing bio waste through consumption and also promote fertility and the growth of local vegetation and forestation. The UN Environment Programme recommends a minimum of 25% open space (plantation and water body combined) within a city's total area whereas according to a 2012 study Dhaka only had 14.5% open space (Shuvo et al., 2014)[57], and whereas a more recent study (2018) indicated that the city only had 8.5% tree covered lands (KMA & D., 2018).[58] According to environmentalists, other cities within the country also suffer from similar problems. As a result, The absence of greenery and biodiversity in urban areas of Bangladesh is visibly evident. Due to rapid rural-urban migration, unplanned urbanization, the rapid increase of urban population, commercial development and industrialization, shifting of existing green spaces to other land use purposes, and lack of conservation activities, the green spaces have

[56] Puppim de Oliveira J.A., Doll C.N.H., Moreno-Peñaranda R., Balaban O. (2014) Urban Biodiversity and Climate Change. In: Freedman B. (eds) Global Environmental Change. Handbook of Global Environmental Pollution, vol 1. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-5784-4_21

[57] Shuvo, Faysal Kabir & Serajul Hakim, Sheikh. (2014). A Proposed Framework for Regenerating Urban Green in Dhaka City. 6. 13-22 - https://www.researchgate.net/publication/273126256_A_Proposed_Framework_for_Regenerating_Urban_Green_in_Dhaka_City

[58] Rahman KMA, Zhang D. Analyzing the Level of Accessibility of Public Urban Green Spaces to Different Socially Vulnerable Groups of People. Sustainability. 2018; 10(11):3917. https://doi.org/10.3390/su10113917

	been reducing. Urban green spaces can play a critical role in conserving biodiversity, protecting water resources, improving microclimate, and sequestering carbon while reducing urban air pollution load and providing purified air. According to an environmental activist, it is essential to consider effective plantation in terms of maintaining urban biodiversity in order to increase the vegetation plantation density and create scope for other components of the biodiversity (Roy et al., 2016).[59] Furthermore, due to industrial waste getting dumped in the water bodies, heavily polluted urban waterways emit toxic gases such as methane and nitrous oxide which are also greenhouse gases. Likewise, fertilizers used in agriculture cause nutrient pollution in the form of runoff into rivers, lakes, and wetlands. The ecosystem then becomes polluted in the process and causes air pollution. In Bangladesh, widespread industrialization is leading towards widespread water pollution. Without adequate water body management, water pollution along with the air we breathe will become more toxic over the years (UNEP, 2019).[60] Urban green spaces such as parks, sports fields, woods, lakesides, and gardens are associated with better air quality, reduced traffic noise, and cooler temperatures. Preserving green spaces and urban water bodies are also essential for protecting the biodiversity (flora & fauna; ecological balance) in urban areas. Engagement Steps: - Commission a study that analyzes the current status quo of urban biodiversity in the country and identifies key elements in the ecosystem crucial in preserving urban air quality. - Conduct workshops with GoB departments, environmentalists, academicians to relate and validate findings - Conduct dissemination meetings with relevant government departments, academicians, environmentalists to contribute to the existing literature available regarding the current status of urban biodiversity within the country to raise stakeholder awareness. - Document case studies of global best examples to ensure amendment of existing policies/formulation of new policies are based on cutting edge international standards - Conduct discussions with relevant stakeholders, environmentalists, academicians to identify and formulate a

[59] S. Roy, S. Dutta and M. M. Hoque. (2016) Urban forestry and urban greening for sustainable urban development-A case of Dhaka north city corporation area (Zone-1). J. Bangladesh Agril. Univ. 14(2): 167–176.
[60] UNEP. (2019). Smart wastewater management can help reduce air pollution. https://www.unep.org/news-and-stories/story/smart-wastewater-management-can-help-reduce-air-pollution

	set recommended guidelines to preserve and restore ecological elements (presence of greenery, waterbodies) that protect biodiversity. - Engage in policy advocacy with relevant government departments to ensure reinforcement of existing policies aimed at preserving urban biodiversity - Limitation The findings and recommendations from this study require a thorough assessment by ecosystem and ecology experts to ensure that the recommendations preserve the local natural ecosystem balance. Furthermore, there is the likelihood of resistance from entities engaging in the rapid destruction of tree-covered lands and water bodies for urbanization and subsequently financial interests. Therefore, there is also a need for proper monitoring and enforcement of implemented policies to ensure sustainable long term impact of policy measures. Furthermore, as with most policy advocacy recommendations, no immediate effect may be noticed on the area of interest (UAP) but will yield lasting results in the long haul in addressing UAP.

Table 21: Technical Assistance Intervention Options

7 Conclusion

The major source of air pollutants, especially in urban areas, in Bangladesh are transportation, construction and industrial activities. These activities currently have a high rate of pollutant emission at the moment as a result of the rapid urbanization in concentrated areas in the country. The activities are also crucial for the national living standards and economic development and thus cannot be easily avoided or halted.

The trends in urban air pollution are similar across the globe and in many places, there are different interventions being undertaken to address the issue with respect to their geographical, cultural and technological constraints. Interventions in Bangladesh, and particularly community-based approaches to address urban air pollution will require a practical rethinking that will make interventions, which are otherwise inapplicable by means of innovation either in the technical, financial or operational phase.

The process of addressing Urban Air Pollution needs adamant steps from multiple angles. There is a need for policy level interventions to curb the sources of pollutants. These should aim for the adoption of global best practices into the major polluting activities (construction, traffic and industry). Additionally, there is scope and need for mass public awareness on various components of air pollutants including sources, ways to curb emissions, ways to address existing pollutants, and green lifestyles. These programs should aim at informing the population and bringing about lasting behavioral change. Lastly, there needs to be a more coherent national level shift towards greener and environmentally friendly practices. This also requires capacity development at all levels including the bottom tier income groups so that greener alternatives become more accessible for all people.

Community based approaches tend to have cultural integration as the basis for long standing impact. This would entail the modeling of interventions which make it easy for communities to integrate the participation as a part of their existing routine. Having communities engage in the development phase of the intervention would serve best to help them realize their stake in the solution and promote willing engagement.

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