

Rising Tides | Changing Lives

The riverine country of Bangladesh is one of the world's most vulnerable countries to climate change due to its geographic location. Nestled between the Himalayan Mountains and The Bay of Bengal, Bangladesh's fragile ecosystem is dotted with hills, lakes, rivers and mangrove forests.

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INTRODUCTION: Forward-Thinking

Each year the Bangladeshi People are in constant battle with natural calamities like cyclones and floods. These annual disasters bring death and destruction to the country, leaving millions of people without homes, food, water and electricity. Rising Tides | Changing Lives is an ongoing research project that investigates the current cultural, climatic and landscape conditions of Bangladesh in an effort to understand how we may begin to develop architectural interventions for such inevitable climate crisis crises.

SITUATION(S)

Bangladesh has an overall population of 156 million people and the world's highest rural population density with 1,200 people/kilometer. This rural population primarily consists of farmers and fishermen, all of whom are dependent upon the world's largest delta to provide a way of life. These waterways are crucial sources of transportation, irrigation and education for the Bangladeshi People.

Each year, between the months of June and October, the monsoons bring an average of 2,500 millimeters of rain to the world's largest deltaic country. The swelling of river ways and rising sea swallows 25,000 acres annually, leaving upwards of 500,000 people homeless and landless. The saline infested waters destroy crops and harm fresh water fish, leaving the rural farmers of Bangladesh in search of both habitation and occupation. In 1995 Bangladesh's largest island, Bhola, was consumed by the sea, leaving 500,000 people homeless. It's estimated that Bangladesh will lose nearly 20% of its land by the year 2030 due to flooding, leaving 20 million people as climate refugees. Knowing this, how can we design for the future?

The question is how does a society prepare for and cope with such inevitable climatic conditions? Is the solution to just pack one's bags and head elsewhere, or is there a way to adapt to conditions and find alternative ways of life through sensitive and sensible architectural interventions?



1

PROBLEM(S)

The annual inundation of Bangladesh and the resulting crowds of climate refugees has proven to put a major strain on Bangladesh's cities like the capital, Dhaka. These sporadic, disastrous weather patterns force rural refugees to flock to Dhaka in search of food, shelter and employment. Unpredictable population influxes result in rapid, unplanned urbanization. This type of seasonal migration is taxing on the city's not-so-ideal infrastructure, water supply, and housing circumstances.

Most climate refugees obtain their basic needs through the development of illegal settlements. For instance, impromptu tent towns literally pop up over night, infiltrating any spare space in sight. These cities, constructed of materials like recycled plastic sheets and discarded bamboo, are typically erected on or near private land, markets, railroad tracks and river beds. In particular, during the dry season, most desiccated riverbeds are made ground for illegal inhabitants.

Nearly 7,600 households live in 44 slums within 50 meters of a river in Dhaka. This process and the pollution that accompanies this aggravated urbanization is a vicious cycle that chokes the city's waterways, thus worsening the floods with each year that passes.

As it stands, Dhaka's infrastructure could use some improvements. The city is laced with traffic jams, pollution, over population, and poor drinking water, not to mention it lacks adequate waste management and urban open space. Dhaka is surrounded on four sides by rivers, The Buriganga to the south), The Turag to the north & west) and The Balu to the east. These waterways are crucial for providing daily basic needs for the population, like transportation, drinking water, bathing water and food supplies. Unfortunately unplanned urbanization, over population and mismanagement has resulted in the deterioration of many of Dhaka's waterways. This network of canals is often times filled with garbage resulting in less storage and drainage capacity which ultimately leads to urban flooding.

Local industry also poses a major threat to Bangladesh's waterways. Major contributors to Dhaka's industrial pollution are the 200 tanneries that line the city's waterways. These factories produce up to 40,000 tons of toxic tannery waste daily, most of which finds its way into the Buriganga River. One of the most contaminated sites in the city is Hazaribagh. With each passing day, these waterways are being severely strangled by the industrial effluents,

Figure 1: Perpetual Motion

Aerial images of Dhaka, Bangladesh demonstrate how the country's landscape is in constant flux due to annual fluvial and pluvial floods. These natural catastrophes swallow land, homes, and businesses leaving thousands of people in search of temporary shelter and basic needs. [Images courtesy Google Earth]



01_STILT SPACES
Dwellings are supported by stilts along some of Bangladesh's water systems. This form of dwelling is not nearly as popular as one would expect given the flood protection that the typology provides. [Image courtesy of Akshay Mahajan]



02_KORAIL SLUM
A pregnant woman sits amidst the bleak environment of the slum in Dhaka, Bangladesh. Thousands of Bangladeshi People are forced to live in slums due to the numerous climatic, social and economical problems that plague the country. [Image courtesy of Saikat Mojumder]



03_HAZARIBAGH TANNERIES
A woman looks for recyclables in front of a tannery in the Hazaribagh area in Dhaka, Bangladesh. [Image courtesy of Andrew Biraj]



04_HAZARIBAGH TANNERIES
A man makes adhesive from leather wastes in Hazaribagh, Dhaka, Bangladesh. The process requires burning which creates huge amounts of toxic smoke that pollute the environment. [Image from an source unknown]

2

household waste, burnt fuel and human excrements that infiltrate the water systems. Bangladesh's river ways are crucial to the country's social and economic survival, thus it's imperative that steps are taken to address and improve these worsening situations.

SOLUTION(S)

Over the years the Bangladeshi people have struggled to find various ways of adapting to the inevitable natural disasters that plague their country. Primary solutions have come in the form of landscape devices, housing transformations and floating vessels.

SOLUTION(S): Landscape Devices

An obvious question is: How can the flow of fluvial and pluvial flood water be controlled and/or contained? Bangladesh has grappled with this problem for centuries, and in the process they have followed the footsteps of flood-prone countries like The Netherlands, by constructing diversion channels and detention areas along volatile waterways. Embankments along river walls have also been constructed to protect Dhaka's West Side from slipping away. Other municipal projects have been put in place to alleviate the water pressure on Dhaka, like the heightening of roads, construction of drainage canals, development of urban lakes and networks of water pipes. Presently there are four lakes in Dhaka West that are used for flood water storage. Thinking that these rather conventional public projects will solve all of Bangladesh's water problems is admittedly naive. Many of Dhaka's holding tanks and water infrastructures are often times transformed into slums since they are only occupied with water for a few months a year. The city continuously makes efforts to clean out and widen its shrinking water systems by dredging the riverbeds, but in many cases this is a losing battle.

Clearly more inventive urban and architectural operations need to be developed that address both the water and housing issues of Bangladesh.

Further upstream from Dhaka the rural farmers of Bangladesh are working to develop ways

Figure 2: Hazaribagh Tanneries

A man makes adhesive from leather wastes in Hazaribagh, Dhaka, Bangladesh. The poisonous process creates huge amounts of toxic smoke and runoff that pollutes Bangladesh's environment. [Image from an source unknown]



3

to work with mother nature and their perpetually evolving landscapes. Each year the rivers that are fed from the Himalayas flow south through Bangladesh, depositing abundant amounts of silt and sand from upstream. Many farmers are now attempting to use this muck to construct barriers that will help protect against floods and the rising sea levels. The farmers also use these muck constructions to channel incoming silt to be deposited where it is most needed; Filling shallow 'soup bowls' and creating land off the coast in an effort to reclaim their lost territory.

SOLUTION(S): Housing Transformations

The Bangladeshi People have developed several housing techniques as methods of adapting to the changing tides. Some of their solutions include entrances that are elevated off the ground using bamboo stilts and units with parking below/living above. These rather traditional solutions are relatively effective, but Bangladesh, Dhaka in particular, is faced with a more severe problem: housing shortages.

Only 1 in 20 Bangladeshi People live in permanent housing. This phenomena is a result of land scarcity, over population and high rents. The majority of Dhaka's apartments are overcrowded and dilapidated. As one of the world's fastest growing cities, Dhaka is in great need of architectural inventiveness that addresses urban dwelling in a way that works with the people and the landscape, not against it. How can contemporary housing solutions be developed for rural migrants in a way that does not infiltrate waterways in a damaging manner? Is there a way to develop a more temporal and/or nomadic dwelling typology that has the capacity to alleviate the congestion that plagues Bangladesh's cities?

In the countryside, Bangladeshi rural dwellers have developed several formal and material techniques in an effort to adapt to their climatic conditions. Unfortunately many of these methods do not hold their strength against fierce flooding. Kutcha and Pucca dwellings are commonly found in rural areas. Kutcha homes are typically made of earthen materials like mud brick, bamboo, timber and plant material. The roofs are often times hatched with grasses which are adhered to a bamboo structure.

These earthen materials are relatively economical and readily available to local farmers. These simple, natural materials create climate controlled spaces that are cool in the heat and warm in the cold without the use of expensive materials and unavailable technology. Pucca

Figure 3: Hazaribagh Tanneries

Tanneries fill the Hazaribagh District of Dhaka, Bangladesh. These un-managed, toxic chemical processes create major environmental issues for the City's vulnerable river systems. *[Image taken by the Author during field work in Bangladesh]*



4

Figure 4: Bathing in The Buriganga River

The Buriganga River is one of the many water bodies that is a major source of life and livelihood for the people of Bangladesh. How does a society prepare for and cope with inevitable climatic crisis conditions? Is there a way to adapt and find alternative ways of daily life through sensitive and sensible architectural interventions? *[Images taken by the Author during field work in Bangladesh]*

dwelling are constructed with foreign materials that are considerably more expensive but also more durable. The foundations, walls, and roofs of Pucca dwellings are constructed with brick and reinforced concrete.

These structures have a longer life span than Kutcha Dwellings, however the cost and lack of climate control has proven to be a significant problem for the Bangladeshi People. These simple dwellings are more-or-less successful in terms of providing adequate shelter, however they remain extremely susceptible to dilapidation and destruction due to inclement weather. Several factors must be taken into consideration when constructing spaces in such a volatile climate. The depth of flood water and duration of its presence can cause considerable damage, resulting in eroding materials and failing structures. Many rural homes are equipped with rain and flood splash protection consisting of detachable panels made of natural straws and grasses. These are easily replaceable with each new monsoon season.

Roof structures are equally important to the comfort and longevity of a Bangladeshi dwelling. Roofs often times equal refuge during these catastrophic situations, therefore they must be durable as well as wind and water resistant. Aerodynamic forms, like in a hip roof, are considered to reduce the amount of suction and uplift in strong winds. Overhangs of 2'6" or greater help to protect the dwelling walls from splashing water. Gutters provide ancillary splash protection and simultaneously collect arsenic free water for consumption.

Ferrocement construction methods are also practiced in Bangladesh where cement, sand and mud and water are mixed and inserted into a metal or wire mesh structure. This form of construction is extremely strong and economical. Ferrocement construction is often used to develop aqueducts, drainage systems, water and septic tanks, water troughs, roofs and small houses.

Many rural Bangladeshi Communities utilize these construction techniques in the development of their introverted homesteads which typically consist of a group of buildings around a central courtyard. Often times each building consists of one room, each of which contains a different program (i.e. sleeping room, cooking room, granary room, etc.). Toilets are located on the periphery along with plant material to reinforce the introverted nature of the settlement.

Many of these rural building techniques are successful on a number of levels, however, the



01_SOLAR SAILS
The boats that Abul Hasanat Mohammed Rezwan and his Bangladesh based NGO Shidhulai Swanirvar Sangstha have designed are all equipped with rooftop solar panels. This allows each boat to collect and store energy which is used for the operation of the boat's motor, computer and lighting systems. [Image courtesy of Shidhulai Swanirvar Sangstha]

02_ISOLATED ISLANDS
Rural communities transform into isolated islands during the monsoon season in Bangladesh. Rezwan's Boat Project brings basic needs to otherwise inaccessible communities. [Image courtesy of Shidhulai Swanirvar Sangstha]

03_PEDDLING POWER
Bicycles are reused to create agricultural irrigation systems. [Image courtesy of Shidhulai Swanirvar Sangstha]

04_BOAT BOYS
All of Rezwan's boats are constructed using local materials and labor. [Image courtesy of Shidhulai Swanirvar Sangstha]

05_SCHOOL SESSION
Countryside Kids appear eager to learn as they attend an educational lesson on a Shidhulai Swanirvar Sangstha Boat. [Image courtesy of Shidhulai Swanirvar Sangstha]

06_BATTERY BOATS
Batteries store the energy that is obtained from rooftop solar panels during the day. These batteries are used to power devices both on the boats and in the homes of the rural village people. [Image courtesy of Shidhulai Swanirvar Sangstha]

07_BUOYANT BOOKS
Each boat is equipped with a library. Some boats contain a small library while others house up to 1500 books, computers, printers and phone services. [Image courtesy of Shidhulai Swanirvar Sangstha]

5

Bangladeshi People have yet to develop a method that conquers the climate crisis at hand. Unfortunately thousands of them are left homeless each year due to the destruction of their beautifully crafted and climate controlled homes. Is there a way to consider these primitive yet powerful existing construction methods with regards to rethinking and perhaps reinventing the way in which societies that are plagued with climate crisis conditions may live in the future?

SOLUTION(S): Floating Vessels

Perhaps an initial attempt at understanding how rising tides are changing lives is the work that has been done by the Bangladeshi architect, Abul Hasanat Mohammed Rezwan. In 1998 he began by building his first boat. He hasn't stopped since.

Rezwan began with the observation that thousands of people in rural Bangladesh were stranded during the monsoon season as a result of flooding and inaccessible roads. Each year nearly 50% of Bangladesh's rural population is left landless without electricity, transportation, communication and education. Rezwan's first boat was constructed of natural materials, 30' long by 15' wide with the capacity to hold 60 people. This boat would be unlike any other boat traversing Bangladesh's water—it would be a floating school to deliver an education to children who are stranded by rising waters.

In 2005 the Bill & Melinda Gates Foundation donated one million dollars to Rezwan's cause. Today he has 88 boats, 42 of which are currently operating and 46 that are being converted into climate shelters. Of the operating vessels, 25 act as schools, 5 as agricultural training centers, 5 as healthcare facilities and 7 as workshop and waste management spaces. In total, Abul Rezwan's fleet serves 90,000 families in a 300-mile radius centered around Singra, Bangladesh.

Figure 5: Isolated Islands

Rural communities transform into isolated islands during the monsoon season in Bangladesh. Abul Hasanat Mohammed Rezwan's Boat Project brings basic needs to otherwise inaccessible communities. [Image courtesy of Shidhulai Swanirvar Sangstha]

ENDNOTES

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Each boat is designed to be flexible, with the ability to adjust to any equipment configuration. A large central truss carries the weight of the roof to allow for adequate open space within the boat. A flat plank floor enables the boat to glide through shallow waters, allowing for maximum access to remote, flood prone locations. The roof is multi-layered to ensure a water free boat interior and topped with solar panels which provide energy for the boats motor, computers and electric lamps. Abul Rezwana's Boat Project brings education, libraries (equipped with 50,000 books), sustainable agriculture, internet access (via 100 computers) and climate change adaptation to a region that at one point seemed otherwise helpless.

CONCLUSION: Thinking-Forward

Rezwana's Boat Project demonstrates how we can begin to seriously consider the consequences of adapting to and coping with climate change. Currently Bangladesh is faced with pressing conditions that must be confronted with every last drop of creative ideology. Can we conceivably live in floating cities, dwell in boats and harvest crops from drifting gardens?

The Rising Tides | Changing Lives ongoing research uses Bangladesh as a laboratory for observation and experimentation. Current and future research and field work attempts to understand the country's present situations and building techniques. Which spatial solutions are succeeding and which are failing? How can relatively primitive building techniques and materials that are native to a people be instrumental in the development of contemporary climate crisis solutions? How can we question normative notions of daily life and speculate about innovative, alternative solutions that adapt to the conditions which currently plague a country that is drowning in climate change.