City Resilience Strategy

Kushtia Municipality, Bangladesh

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1. BACKGROUND

1.1 Introduction

It is projected that over 60% of the world's population will be based in cities by the year 2030¹. Bangladesh is gradually making the shift from 'rural' to 'urban'. Though the level of urbanization is still rather low, only 28.4 percent, it however already had a very large population 42.7 million in 2011, living in nearly 570 urban centres in the country. Projections, keeping in mind the growth rates of population observed during 2001-2011 and based on the UN population projection model, indicate that Bangladesh would achieve 'the tipping point' of 50 per cent urban by 2047. Thus, Bangladesh is expected to be majority 'urban' within the next 35 years². Due to high concentrations of people, infrastructure and resources, the most adverse impacts of climate change will likely be in these areas according to the World Bank³. In this context, it is of the utmost urgency that a city is able to increase climate resilience to avoid these impacts.

Climate resilience is defined as the capacity for a socio-ecological system to: (1) absorb stresses and maintain function in the face of external stresses imposed upon it by climate change and (2) adapt, reorganize, and evolve into more desirable configurations that improve sustainability of the system, leaving it better prepared for future climate change impacts⁴. **Urban Climate Change Resilience (UCCR)** is defined by Rockefeller Foundation as the **capacity** of cities (individuals, communities, institutions, businesses and systems) to **survive**, **adapt**, **thrive** in the face of stress and shocks, and even **transform** when conditions require it⁵.

There are a host of benefits for cities associated with building resilience as outlined in Table 1. Investing in resilience reduces losses and damages in the event of a disaster. However, even if the anticipated disaster does not occur for a long time, increased resilience will mean reduction in background risk and unlocking of economic development potential⁶.

Economic Benefits			vironmental Benefits	Social Benefits		
-	Avoidance of runaway	-	Biodiversity conservation	-	Improved public health	
	costs of climate change	-	Preservation of vital	-	Decreased mortality	
-	Livelihood creation		ecosystems and species	-	Increased benefits to	
-	Higher savings by	-	Conservation of water		low-income households	
	population, businesses		resources	-	Reduced damage and	
	and government	-	Improved practices for		loss due to natural	

¹United Nations. 2014. World Urbanization Prospects, the 2014 revision. UN Department of Economic and Social Affairs, Population Division.

² Islam N. 2015. Urbanization in Bangladesh: Challenges and Opportunities <u>http://www.shiree.org/wp-content/uploads/2015/04/NI-Paper.pdf</u>

³World Bank, 2008. Climate Resilient Cities: A primer on reducing vulnerabilities to climate change impacts and strengthening disaster risk management in East Asian cities, Washington D.C.

⁴ Folke, C. 2006. "Resilience: The emergence of a perspective for social-ecological systems analyses". Global Environmental Change. **16**: 253–267.

⁵The Rockefeller Foundation. 2015. Insights from the Asian Cities Climate Change Resilience Network: Urban Climate Change Resilience in Action: Lessons from Projects in 10 ACCCRN Cities.

⁶ Tanner, T.M. and Rentschler, J. 2015. 'Unlocking the 'Triple Dividend' of Resilience: Why investing in disaster risk management pays off. Interim Policy Note'. Washington D.C.: GFDRR and London: Overseas Development Institute (www.odi.org/tripledividend).

Ec	onomic Benefits	Environmental Benefits	Social Benefits
- Reduced risks associated		disaster risk reduction	disaster
with current climate			- Enhanced well-being of
variability			all social groups

1.2 Methodology

Kushtia's City Resilience Strategy was formulated using the ICLEI ACCCRN Process (IAP). The process helped to identify fragile urban systems, major climate risks to urban systems and vulnerable areas and populations in the city, which were used to formulate resilience interventions.

Pioneered by the Rockefeller Foundation, the Asian Cities Climate Change Resilience Network (ACCCRN) supports practitioners to build inclusive urban climate change resilience in over 50 rapidly urbanising cities. To facilitate this initiative, the IAP toolkit was developed which targets city governments and helps them develop their city resilience strategies with little or no external assistance.

1.2.1 Overview of ICLEI ACCCRN Process

The IAP toolkit consists of a set of sixteen tools which enables local governments to assess the climate risks of various systems in the city in context of urbanization and vulnerability, and plan resilience interventions corresponding to the fragilities identified. The IAP is designed in a stepby-step format, divided into following six phases as shown in Figure 1.





Phase 1 – Engagement: This phase begins with gaining political support in the city by formulating a Climate Core Team and a Stakeholder Committee. The climate core team is responsible for the execution of project activities in the city and comprises of key officials from the city government. The Stakeholder Committee is formed with citizen representatives from various relevant institutions and organisations of the city. The climate core team forms a communication plan for the city highlighting key messages to be conveyed to the public and the ways for doing so. This is

followed by a scoping exercise which helps in gaining insight about the various city services and the problems faced by the city.

Phase 2 – Climate Research and Impact Assessment: This phase identifies the main impacts of climate change faced by city through Shared Learning Dialogues (SLD) with the Climate Core Team and Stakeholder Committee. An assessment of the past climate trends and future climate projections are conducted through secondary research. These are validated through analysis of city level data as well as local perceptions from city stakeholders. A risk assessment is conducted for fragile urban systems based on the likelihood and consequence of the climate risk statements for those systems.

Phase 3 – Vulnerabilities Assessment: This phase helps in identifying the key vulnerable areas with the fragile urban system and the vulnerable population for each system. This information is gathered in consultation with the Stakeholder Committee through SLD. The adaptive capacities of the urban systems are also assessed in this phase.

Phase 4 – Resilience Strategy: In this phase, the city government uses the information and analysis from the previous phases to identify the relevant resilience interventions. These interventions are prioritised on the basis of their feasibility and applicability to the city. The resilience strategy is then developed and ratified through political support.

Phase 5 & 6 – Implementation and Monitoring & Review: After identifying the resilience interventions for the city, concrete project implementation plans can be prepared. Opportunities for financing and implementing these projects need to be explored. In all cases, monitoring and review remains a mandate of the city government, with active involvement of the Climate Core Team.

1.2.2 IAP in Kushtia City

Honourable Mayor and town planner in Kushtia Municipality spearheaded the IAP with support from other city officials, councillors and ICLEI South Asia. Figure 2 illustrates the process and timeline followed in Kushtia. To initiate the IAP, municipal town planner, engineers, councillors and other representatives from Kushtia Municipality, were oriented on the fundamentals of urban development and climate resilience. Simultaneously, members for the Climate Core team and the Stakeholder committee were identified in consultation with the Mayor, Town Planner and Municipal Engineer of the Kushtia Municipality. The potential climate risks were identified by an assessment of the trends of temperature and precipitation change in the area and desktop studies of secondary literature. These were validated by the Climate Core Team and Stakeholder Committee in an SLD.

Through the SLD and other consultations/discussions, a comprehensive Urban Systems Analysis was carried out that identified five urban systems as fragile, viz. (i) Water Supply System and River System Management, (ii) Health System, (iii) Economy, (iv) Drainage and Sewerage (v)Transportation. The five fragile urban systems identified were critically analyzed considering the direct and indirect impacts of identified climate risks. Transportation which scored medium in the assessment was not considered for further analysis. Through another SLD, Vulnerability Assessment was carried out to critically evaluate the sensitivity, exposure and adaptive capacity of the fragile urban systems, identify vulnerable areas for each climate risk and their associated

vulnerable actors. Finally, the vulnerability hotspots, reflecting the fragility of a ward, were arrived at by overlaying all the vulnerable wards identified under each fragile urban system.

A list of resilience interventions targeting improved urban resilience and reduced climate risk for all fragile urban systems was developed. These were assessed for their technical, social and financial feasibility and their applicability to Kushtia. Interlinkages of these resilience interventions with on-going and planned projects were established and further integration into existing city-level plans was explored.



Figure 2: Methodology of IAP in Kushtia

2. CITY PROFILE

Kushtia is the most populous city of Kushtia district. It is located between 23°42′ and 23°59′ north latitudes and between 88°55′ and 89°04′ east longitudes. The city consists of a Paurashava (Municipality) with 12 wards and 36 mahallas. Kushtia Municipality was established in 1869. Under the Municipal Administration Ordinance of 1960, the Kushtia Municipality was converted into a Municipal Committee. In accordance with the Bangladesh Local Councils and Municipal Committees (Amendment) Order of 1972, Kushtia Municipal Committee was reconstituted as Kushtia Paurashava.

2.1 Location

Kushtia district is bounded on the north by Rajshahi, Natore and Pabna districts, on the east by Pabna and Rajbari Districts, on the south by Jhenaidah, Chuadanga and Meherpur Districts and on the west by Chuadanga and Meherpur Districts and India. Kushtia Municipality is located in the district of Kushtia under Khulna Division. It is situated in the south-western part of Bangladesh lying just south of the upper Padma River. Kushtia city is the oldest city of the district (refer Figure 3).



Figure 3: Location of Kuahtia Municipality

2.2 Demography⁷

Kushtia Municipality has a total population of 375,149 of which 195,134 are male and 180,015 are female. There are approximately 75,000 households distributed among 21 wards occupying a total area of 42.79 sq. km. where, ward 5 and 11 are the most and least populated wards, respectively. Population density is 8,037 per sq. km. The literacy rate in the area under the jurisdiction of the municipality is 74.6%.

2.3 Economy and Employment

Kushtia produces a large amount of rice. It has a big commercial area named Bisic Shilponogory which has a tobacco factory manufacturing a famous brand (British American Tobacco). Since 1986, a few companies (Rajib rice mill, Rupali rice mill and Dada agro food) started a rice processing business and today there are almost 350 rice mills in Kushtia, playing an important role in the national economy.

2.4 Municipal Administration

Kushtia Municipality regulates most of the civic functions and services in the city. At present, the City Corporation consists of elected members including a Mayor and 21 Councillors, including 7 female Councillors. The Mayor and Councillors are responsible for all policy decisions. There is a

⁷ <u>http://www.kushtiamunicipality.org/Demographic%20Information.html</u>

position for Chief Executive Officer (CEO) who is the head of city corporation administration and is responsible for the functioning of the Corporation including tax collection, estates maintenance, projects, among other things. This is an administrative cadre service post and appointed by the central government. Kushtia Municipality provides and maintains basic urban services which include water purification and supply, sanitation and drainage, garbage disposal and street cleanliness, solid waste management, building and maintenance of roads and streets, street lighting, maintenance of parks and open spaces, cemeteries and crematoriums, registering of births and deaths, conservation of heritage sites, disease control including immunization, and public municipal schools.

3. PAST HAZARDS AND CLIMATIC EVENTS

Kushtia and adjacent districts fall under the disaster-prone region of the country where flood, river erosion, cyclone, drought are almost a yearly phenomenon. Daulatpur Upazila of Kushtia is very prone to severe river erosion⁸.In 2003, one person was killed and over 200 were injured as a tornado lashed Pabna, Kushtia, Manikganj and Natore⁹.Villages were swept away, infrastructure and houses were damaged and trees were uprooted.

Flooding is extremely common in the entire district. The floods of 2000¹⁰, saw many areas in Daulatpur, Bheramara, Mirpur, Khoksha and Kumarkhali Upazilas being submerged as a result of the water levels in the Padma and Garai rivers rising. At least 8000 people were marooned and more than 10,000 acres of croplands affected. In 2013¹¹ the floods affected over 35 villages, destroyed 1500 ha of crop land and displaced hundreds of people. In 2016, due to a downpour, the rivers in the district overflowed leading to river erosion, displacing at least 300 families and leading to a spike in the number of water borne diseases¹². Arable lands, dwelling, trees and the fields of standing crops were damaged.

Table 2 depicts some of the bigger disaster events in Kushtia.

Hazard Event	Year	Impacts of Hazardous Events	
Flood	2000	8000 people were marooned; more than 10,000 acres of	
		croplands affected.	
Tornado	2003	One person was killed; over 200 people injured; Villages were	
		swept away; damage to infrastructure and houses; trees were	
		uprooted.	
Floods	2013	Over 35 villages affected; destroyed 1500 ha of crop land ;	
		displaced hundreds of people	
Excess rainfall 2016		River erosion; displacing at least 300 families; spike in the	
		number of water borne diseases; Arable lands, dwelling, trees	

Tahle	2:	List	of	Hazard	lous	Events
rubic	۷.	LISt	UJ.	nuzuru	1005	LVCIILS

⁸Government of Bangladesh. 2014. Disaster report 2013. Department of Disaster Management; Ministry of Disaster Management and Relief, Government of Bangladesh, Dhaka.

⁹ http://archive.thedailystar.net/2003/10/10/d31010012222.htm

¹⁰ <u>https://article.wn.com/view-lemonde/2000/09/12/Kushtia_flood_worsens/#/related_news</u>

¹¹ http://www.risingbd.com/english/Flood_engulfs_35_more_villages_in_Kushtia/5922_

¹² http://archive.dhakatribune.com/bangladesh/2016/jul/24/flood-worsens-6-districts

Hazard Event	Year	Impacts of Hazardous Events	
		and the fields of standing crops were damaged.	

4. CLIMATE SCENARIO IN THE CITY

The annual average temperature of Kushtia district varies from a maximum 37.8° C to minimum 11.2° C and annual average rainfall is 1467 mm.

4.1 Past Climate Trends

According to a report¹³-Climate: Observations, Projections and Impacts for Bangladesh-since the1960s there has been widespread warming during both the hot season (March to May) and cool season (December to February). There has been a reduction of the number of cool nights and an increase in the number of warm nights over the period 1970-2000. In terms of precipitation, since the 1960s there has been a small increase over Bangladesh.

A MET report¹⁴ on the Climate of Bangladesh found that the amounts of rainfall decreased over Rajshahi division and the regions of Faridpur, Dhaka, Sylhet, Kushtia and Barisal during 1981-2010. The report also found that during winter season, maximum temperature decreased over Rajshahi division and the regions of Dinajpur, Kushtia, Tangail & Mymensingh.

As there are no specific local or city level assessments by the government of Bangladesh, hence the past climate trends of Kushtia city using climate data collected from the Bangladesh Meteorological Department (BMD) have been analysed. The data spans 30 years from 1984 to 2014 for both temperature and rainfall.

Figure 4 shows that the average annual rainfall is decreasing by almost 35mm over the last three decades. This is due to a clear decrease in rainfall across all seasons (Figures 5-8). Rainfall received in 2014 has been very poor with post monsoonal rainfall (September to December) showing 0mm recorded (Figure 7 and Figure 8).

¹³Met office and University of Nottingham.2011. Climate: Observations, projections and impacts: Bangladesh. Developed at the request of the Department of Energy and Climate Change. U.K. <u>http://eprints.nottingham.ac.uk/2040/6/Bangladesh.pdf</u>

¹⁴Khatun M.A., Rashid, M.B. and Hygen H.O. 2016.MET report, Climate of Bangladesh. Norwegian Meteorological Institute. ISSN 2387-4201 <u>http://met.no/filestore/Report08-16ClimateOfBangladesh2.pdf</u>





Figure 4: Average Annual Rainfall for Kushtia City

Figure 5: Rainfall in Summer for Kushtia City



Figure 6: Rainfall in Rainy Season for Kushtia City



Figure 7: Rainfall in Autumn for Kushtia City



Figure 8: Rainfall in Winter for Kushtia City

Temperature on the other hand has been steadily increasing over the data period (Figures 9-11) and annual average temperature shows that the increase in the three decades is almost 0.5°C (Figure 9). Both maximum and minimum temperatures show a rise over the analysis period (Figure 10 and Figure 11).



Figure 9: Annual Average Temperature for Kushtia City







Figure 11: Annual Minimum Temperature for Kushtia City

4.2 Climate Change Projections and Climate Scenario Statements

Although there is no dedicated literature available detailing climatic projections for various regions in Bangladesh, the National Plan for Disaster Management (2010-2015)¹⁵ published by the Government of Bangladesh and the Vulnerability, Risk Reduction and Adaptation to Climate Change, Climate Risk and Adaptation Country profile, (2011) published by World Bank¹⁶ is referred to. The National Plan for Disaster Management used a regional climate model PRECIS for Bangladesh.

Table 3: Climate	Scenario	Statement
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Changing Climate Conditions	Assessments	Climate Scenario Summary Statements				
Precipitation	National Assessment ¹⁵	Pre-monsoon rainfall will decrease while				

¹⁵Government of Bangladesh. 2010. National Plan for Disaster Management, 2010 – 2015, Disaster Management Bureau Disaster Management & Relief Division, Government of Bangladesh

¹⁶The World Bank Group. 2011. Vulnerability, Risk Reduction and Adaptation to Climate Change. Climate Risk and Adaptation Country profile, Bangladesh. The World Bank Group, Global Facility for Disaster Reduction and Recovery, Climate Investment Funds.

http://sdwebx.worldbank.org/climateportal/countryprofile/doc/GFDRRCountryProfiles/wb_gfdrr_climate_change_cou ntry_profile_for_BGD.pdf

Changing Climate Conditions	Assessments	Climate Scenario Summary Statements
change		monsoon and post-monsoon rainfall will
		increase. From 2051 onwards annual
		average rainfall and monsoon rainfall will
		follow a higher increasing trend.
	National Assessment ¹⁶	There will be an increase in the amount of
		run-off, and rainfall intensity.
Temperature	National Assessment ¹⁵	The monthly average maximum
change		temperature will increase during the
		monsoon period and will decrease in other
		periods. The monthly average minimum
		temperature will increase in all periods and
		the Annual Maximum and Minimum
		temperature will follow an increasing trend.
	National Assessment ¹⁶	Mean temperatures across Bangladesh are
		projected to increase between 1.4°C and
		2.4°C by 2050 and 2100, respectively.

Observations from stakeholders of Kushtia indicate that although temperatures are increasing in the city, rainfall is declining. Rainfall is showing changes in patterns with the monsoon season shifting to later months and amount of rainfall becoming irregular, with excessively high or low rainfall. It is possible that the prevailing perception of declining rainfall is because of the shift in the monsoon season, due to which rain is less in monsoon than usual.

Thus the climate risks as agreed upon by stakeholders were:

Climate risk 1: Increased temperatures

Climate risk 2: Irregular rainfall

5. CLIMATE IMPACT ASSESSMENT

Climate impact assessment of urban systems helps to assess their fragilities with respect to the climate impacts identified earlier. These urban systems could include **'core systems'** such as water, sewerage, transport which are essential for running the city and **'secondary systems'** such as health, education, sanitation which rely on the core systems. The urban system analysis in Kushtia identified five fragile urban systems through rigorous discussions in the SLDs. These are,

- (i) Water Supply System and River System Management
- (ii) Health System
- (iii) Economy
- (iv) Transportation
- (v) Drainage and Sewerage

5.1 Urban Systems Analysis

5.1.1 Water Supply System and River System Management

Situation Analysis

Only ground water is used for water supply to the municipality. The ground water has a high content of iron and there are three treatment plants in the municipality to treat this water before supply. There are four overhead tanks that store water which is pumped from 14 tubewells. The piped water system has a total pipeline length of 109.5km. Only 46% of residents have access to this water supply. The rest depend on 3,200 hand pumps and 40 street hydrants. According to the municipality¹⁷, the total demand for water is 9,500 cubic meter per day and the production capacity in the municipality is 10,300 cubic meter per day.

The ground water levels are steadily decreasing as demand increases, as the rains fail, as the temperature goes up and as the river dries. Tubewells must be dug deeper and deeper in order to access the lowering water table. Given the limited capacities of the water treatment plants, to cope with demand, mixed water (water with iron content) is being supplied to the municipality.

The municipality is in the delta of the Gorai and Kaliganga Rivers and the water level in these are going down due to less rainfall over the years. This in turn is impacting the water supply to the city.

Fragility Statement and Climate Fragility Statement

Considering the present situation of Water Supply in Kushtia, the urban fragility statement of this system is 'The water supply system is fragile because only ground water serves as a water source in the city and lowering level of ground water will lead to greater water stress. This needs to be addressed by Rain Water Harvesting and River water use.'

Considering the present situation of the water resources in Kushtia, the urban fragility statement of this system is 'The River is drying up and impacting the existing ground water level, thereby impacting water supply system.'

The climate fragility statement for this system is:

"Climate Risk 1: Increasing temperatures and irregular rainfall will create greater demand for water and put the system under stress. This will impact municipal finances and human health."

"Climate Risk 2: Water level of river needs to be improved and will be impacted further due to high temperatures and irregular rainfall, having impacts on transport, water supply and thereby economy and health."

5.1.2 Health System

Situation Analysis

Kushtia Municipality has three government hospitals with a capacity of 250 beds and is staffed by 51 doctors and 77 nurses. Additionally there are 67 private institutions which contribute to a

¹⁷ http://www.kushtiamunicipality.org/Water%20Supply.html

total of 710 beds, 158 doctors, 233 nurses and 113 technicians in the municipality¹⁸. Health of citizens is impacted because of high temperature and less rainfall - more heat strokes and diarrhoea is seen.

The municipality is providing primary health care services to the city people through three (3) primary health care centres under Urban Primary Health Care and Service Delivery Project (UPHCSDP). While free service is being provided to urban poor through the aforementioned centres, the facilities are not sufficient neither is the staff equipped to deal with climate change related health impacts. Private hospitals are available, but cannot be accessed by a large section of the people (urban poor).

Fragility Statement and Climate Fragility Statement

Considering the present situation of Health in Kushtia, the urban fragility statement of this system is 'Health system in the city is fragile because of inadequate facilities available that cannot cope with the demand.'

The climate fragility statement for this system is:

"Climate Risk 1: Increasing temperatures and irregular rainfall will increase the incidence of heat strokes and diarrhoea that cannot be tackled by the inadequate health facilities available in the city."

5.1.3 Economy

Situation Analysis

Agriculture is an important source of livelihood for the poorer residents of Kushtia and there are many rice mills in the city. The main occupations are agriculture 21%, agricultural labourer 17%, wage labourer 4%, commerce 19%, service 13%, industry 9%, transport 5% and others $12\%^{19}$. Agriculture is typically done by women farmers across the city. Livestock is also reared for animal products and there is a thriving leather industry in Kushtia.

In an economy which is dependent on agriculture, and its natural resources (fishery and livestock), periods of drought or climatic disaster events can severely impact the livelihood of people. The leather produced is deteriorating in quality due to loss of hair in animals caused by excessive heat and lower rainfall.

Fragility Statement and Climate Fragility Statement

Considering the present situation of the economy in Kushtia, the urban fragility statement of this system is 'The economy of Kushtia is dependent on agriculture, fishery, livestock that is impacted by climatic changes. Industries such as the leather industry are dependent on animals that are impacted by climate change.'

 ¹⁸Bangladesh Bureau of Statistics (BBS). 2013. District Statistics 2011 Kushtia. Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID); Ministry of Planning; Government of the People's Republic of Bangladesh.
 ¹⁹ <u>http://bangladeshcontinual.blogspot.in/2011/06/kushtia.html</u>

Agriculture, fishery, livestock is heavily dependent on regular seasonal cycles and is severely and erratically impacted by climatic change, therefore the climate fragility statement for this system is:

"Climate Risk 1: Irregular rainfall will impact crop cycles, fishery and fruit production by impacting the pest life cycle. Leather industry will be impacted due to impacts on skin of animals caused by climate change. Women will be the most impacted since agriculture is done mostly by women."

5.1.4 Transportation

Situation Analysis

The transportation system in the Kushtia is well established. The main transport modes in the city are train, buses, mini buses, cars and rickshaws. Kushtia is well connected by highways, waterways and railways to the rest of Bangladesh and capital city Dhaka, as well as other parts of Khulna, Rajshahi, Rangpur, Chittagong, Barisal, and Sylhet. Government owned Bangladesh Road Transport Corporation (BRTC) provides bus services to Khulna and other cities.

The city has 290km of roads of which 75 km are kachha roads²⁰. The number of main roads in the city is limited and sometimes leads to traffic congestion. Furthermore, the road infrastructure gets damaged during rainfall events further impacting vehicle movement.

Fragility Statement and Climate Fragility Statement

Considering the present situation of the transportation system in Kushtia, the urban fragility statement of this system is 'The road infrastructure is unable to handle the growing traffic flow in the city.'

The climate fragility statement for this system is:

"Climate Risk 1: Excess rainfall will damage roads and impact transportation in the city."

5.1.5 Drainage and Sewerage

Situation Analysis

The topography of Kushtia Municipality is almost a flat alluvial and sandy clay plain which is formed as a delta between the rivers Gorai and Kaliganga. The northern and eastern periphery of the Municipality is surrounded by these two rivers which act as natural boundaries. The total drainage length in the city of Kushtia is 260 km. Of this 80km is brick lined while 100km is Reinforced Concrete Cement lined and 80km are primary drains or Khals²¹.

The municipality has a low coverage of drains and most are open. As a result solid waste often gets disposed into them resulting in clogging, lowering the drainage efficiency of the drains. During rainfall events, these drains, unable to take the increased volume of water, overflow and the city is water logged.

²⁰ <u>http://www.kushtiamunicipality.org/Road%20Network.html</u>

²¹ http://www.kushtiamunicipality.org/Drainage%20System.html

In a survey by Sinha²² (2014) it was found that only 50.33% of households have septic tank toilets and 48.67% have ring slab or single pit or twin pit toilets. The municipality provides a Septic-Tank/Pit Latrine emptying service to the city people through its 4 Vacutug²³; however, there is no formal or environmentally sound faecal sludge disposal system. Furthermore, many households just empty the contents of their septic tanks into the open drains. The drains end up linking with the Kali River whose water is used for drinking or cooking purposes by the urban poor living near the river.

Municipal authorities and the people in general, are not aware of the seriousness of the problem and therefore of the needs for improvement. Financial and operational capacity of the municipalities for improved faecal sludge collection, treatment and safe disposal are also limited.

Fragility Statement and Climate Fragility Statement

Considering the present situation of the drains and sewerage system in Kushtia, the urban fragility statement of this system is 'There is poor coverage of drains in the city and open drains get clogged during events of excess rainfall. Inadequate coverage of sewerage management systems, leads of overflowing and tendency of people to let the sewerage flow into the rivers.'

The climate fragility statement for this system is:

"Climate Risk 1: Sudden increases in rainfall will impact drainage of certain areas because of low coverage, impacting health."

"Climate Risk 2: Increased temperatures and irregular rainfall can impact sewerage flow and discharge in the nearby rivers, thereby impacting health of downstream people."

The urban fragility statements and climate fragility statements are explained in Annexure 1.

5.2 Risk Assessment

The climate risks associated with the fragilities of these systems were calculated through a risk assessment exercise conducted by the Stakeholder Committee during the SLD. The fragile urban systems with the highest risks as per the assessment were investigated further.

The risk score for each climate fragility statement is defined as a combination of the likelihood of an event to occur and the consequences faced if the event occurred. The process followed for risk scoring is detailed in Annexure 2. Table 4 shows the risk status of the climate fragility statements.

Urban System	Impacts of Climate Change	Risk Status
Water Supply	Increasing temperatures and irregular rainfall will create	
System and	greater demand for water and put the system under stress.	Extreme
River System	This will impact municipal finances and human health.	

²²Sinha.A.H.M.M. 2014. Opportunity of Low Cost Solution for Faecal Sludge Management to Improve Urban Sanitation Situation: Experience in Bangladesh. Presented at Policy Dialogue on Sustainable Urbanization in South Asia: Greening the Infrastructure Gap 17-18 December, 2014 New Delhi, India.

²³ <u>http://www.kushtiamunicipality.org/Sanitation.html</u>

Urban System	Impacts of Climate Change	Risk Status
Management	Water level of river needs to be improved and will be impacted further due to high temperatures and irregular rainfall, having impacts on transport, water supply and thereby economy and health.	Extreme
Health System	Increasing temperatures and irregular rainfall will increase the incidence of heat strokes and diarrhoea that cannot be tackled by the inadequate health facilities available in the city.	Extreme
Economy	Irregular rainfall will impact crop cycles, fishery and fruit production by impacting the pest life cycle. Leather industry will be impacted due to impacts on skin of animals caused by climate change. Women will be the most impacted since agriculture is done mostly by women.	High
Transportation	Excess rainfall will damage roads and impact transportation in the city	Medium
Drainage and Sewerage	Sudden increases in rainfall will impact drainage of certain areas because of low coverage, impacting health.	High
	Increased temperatures and irregular rainfall can impact sewerage flow and discharge in the nearby rivers, thereby impacting health of downstream people.	High

Based on this risk assessment, water supply and river system management as well as health are at extreme risk while the economy and storm water drainage and sewerage are at high risk from climatic impacts. Transportation which scored medium was not taken up in subsequent analyses and can be put on a lower priority for the city.

6. VULNERABILITY ASSESSMENT

6.1 Overview

In order to build resilience there is a need to understand the extent of vulnerability of the city to climate change. This vulnerability depends upon the geographical location, demography, infrastructure, socio economic condition, ecological condition of the city. The Intergovernmental Panel on Climate Change (IPCC, 2007)²⁴ defines vulnerability as a function of three parameters of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

²⁴IPCC, 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Annex I., M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK.



Figure 12: Vulnerability Constituents²⁴

Vulnerability assessment through the IAP consists of identification of areas vulnerable to the identified climate risks and actors for all the prioritized climate fragility statements of the fragile urban systems and analysis of the adaptive capacities of the actors and the urban systems. Vulnerability assessment of Kushtia city was carried out in consideration of the following elements:

- **1. Identification of Vulnerable Places**: Areas that are highly vulnerable to the identified fragile urban systems of the city were identified and mapped to arrive at vulnerability hotspots affected by maximum number of fragile urban systems.
- 2. Identification of Vulnerable actors and their adaptive capacity: In each of the vulnerable areas, the actors that play a critical role towards building urban resilience were identified and assessed in terms of their capacity to organize and respond to threat or disruption, access to resources necessary for response (manpower, technology, funds) and access to information necessary to develop effective plans and actions and to improve responses to disruptions. These determine the adaptive capacity/resilience of the identified actors for a particular fragile system.
- **3.** Assessment of Adaptive Capacities of Urban Systems: Adaptive capacity of urban systems is its capacity to absorb and respond to shocks that determines their resilience. The adaptive capacity was determined in the context of economy, technology/infrastructure, governance, social systems and ecosystems.

The sections below identify the vulnerable areas, vulnerable actors and adaptive capacity of the fragile urban systems using the Climate Fragility Statements developed in consultation with the Stakeholder Committee.

6.2 Identification of vulnerable areas of Fragile Urban Systems

6.2.1 Water Supply System and River System Management: Vulnerable Areas

Climate Fragility Statements	Area/ward most vulnerable
Increasing temperatures and irregular rainfall will create	Wards - 1, 2, 3, 7, 10, 13, 14, 15,
greater demand for water and put the system under	16 (Figure 13).

Climate Fragility Statements	Area/ward most vulnerable
stress. This will impact municipal finances and human	
health.	
Water level of river needs to be improved and will be	
impacted further due to high temperatures and irregular	
rainfall, having impacts on transport, water supply and	
thereby economy and health.	



Figure 13: Wards most vulnerable to climate risks in the context of Water Supply System and River System Management, Kushtia

6.2.2 Health System: Vulnerable Areas

Climate Fragility Statements	Area/ward most vulnerable
Increasing temperatures and irregular rainfall will increase	1, 2, 3, 6, 10, 13, 17, 18, 20, 21
the incidence of heat strokes and diarrhoea that cannot be	(Figure 14).
tackled by the inadequate health facilities available in the	
city.	





6.2.3 Economy: Vulnerable Areas	
Climate Fragility Statements	Area/ward most vulnerable
Irregular rainfall will impact crop cycles, fishery and fruit	Wards - 13, 14, 15, 16, 17, 20,
production by impacting the pest life cycle. Leather industry	21 (Figure 15).
will be impacted due to impacts on skin of animals caused	
by climate change. Women will be the most impacted since	
agriculture is done mostly by women.	



Figure 15: Wards most vulnerable to climate risks in the context of Economy, Kushtia

6.2.4	Drainage and Sew	erage: Vulnerable Areas
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Climate Fragility Statements	Area/ward most vulnerable		
Sudden increases in rainfall will impact	Wards - 13 to 21 (no drains in extended areas),		
drainage of certain areas because of low	Wards - 6 - drainage is bad in certain areas of		
coverage, impacting health.	housing estate, government college		
	Wards 4, 5, 7 - border of Mahatabuddin Sadak,		
	Ward 9 - Rajarhat, G K Siphon (Figure 16).		
Increased temperatures and irregular	Wards 13, 14, 15, 16, 17, 18, 19, 20, 21 as no		
rainfall can impact sewerage flow and	septic tanks are there, pockets of the city in		
discharge in the nearby rivers, thereby	other wards are also vulnerable (Figure 16).		
impacting health of downstream people.			



Figure 16: Wards most vulnerable to climate risks in the context of Drainage and Sewerage, Kushtia

All areas in the city are impacted by more than one fragile urban system. The places that are facing threats from all five fragile urban systems are referred to as the vulnerability hotspots. In Kushtia, wards 13, 14, 15 and 16 were identified as the vulnerable hotspots. These wards are closer to the river banks and house large urban poor populations and lack basic infrastructure.

The remaining wards in the city are also impacted by 2 or more fragile systems. The hotspots in the city need particular attention. Figure 17 shows the vulnerability hotspots in the city.

Figure 17: Consolidated Vulnerable Hotspots for Kushtia city.

6.3 Actor Analysis

This section focuses on the analysis of the adaptive capacities of urban actors identified within the vulnerable wards. On the basis of their capacity to respond to climatic impacts, the actors are

divided into vulnerable actors or supporting actors. Table 5 below shows the adaptive capacities of the actors for each fragile urban system.

The municipality and government departments like the Bangladesh Water Development Board (BWDB) and Department of Public Health and Engineering (DPHE) scored high in the adaptive capacity, since they have access to technical and financial resources and to information, therefore they have the ability to respond to stresses. Among citizens, slum dwellers, farmers, fishermen have low adaptive capacity because of low financial and technical resources available to them. So even if information is made available, they are unable to act on it. Children and elderly are particularly vulnerable to health risks caused by sewerage and drainage issues. Annexure 3 gives the scoring of the actors.

Fragile			Level of	
Urban	Climate Fragility Statements	Actors	Adaptive	
System		vulnerable		Capacity
Water Supply	Increasing temperatures and	Wards - 1, 2,	Municipality	High
System and	irregular rainfall will create	3, 7, 10, 13,	Department of	Medium
River System	greater demand for water	14, 15, 16	Public Health	
Management	and put the system under		and Engineering	
	stress. This will impact		(DPHE)	
	municipal finances and		Slum Dwellers	Low
	human health.		Residents	Low
	Water level of river needs to		Farmers	Low
	be improved and will be		Fishermen	Low
	impacted further due to high		Women	Low
	temperatures and irregular		Bangladesh	High
	rainfail, naving impacts on		Water	
	thereby according thereby and		Development	
	thereby economy and health.		Board (BWDB)	
Health	Increasing temperatures and	1, 2, 3, 6, 10,	Municipality	High
System	irregular rainfall will increase	13, 17, 18, 20,	DPHE	Medium
	the incidence of heat strokes	21	Civil Surgeon	Medium
	and diarrhoea that cannot be		Office	
	tackled by the inadequate		Children	Low
	health facilities available in		Daily Labourer	Low
	the city.		Rickshaw	Low
			Pullers	
			Elderly	Low
Economy	Irregular rainfall will impact	Wards - 13,	Municipality	High
	crop cycles, fishery and fruit	14, 15, 16, 17,	Businessmen	Medium
	production by impacting the	20, 21	Farmers	Low
	pest life cycle. Leather		Daily Labourer	Low
	industry will be impacted due		Fishermen	Low

Table 5: Analysis of the adaptive capacities of local actors identified

Climate Fragility Statements	most vulnerable	Actors	Adaptive Capacity
to impacts on skin of animals		Women	Low
caused by climate change.		Street Vendors	Low
Women will be the most		Livestock	Low
impacted since agriculture is		rearers	
done mostly by women.			
Sudden increases in rainfall	Wards – 4, 5,	Municipality	High
will impact drainage of	6, 7, 9, 13, 14,	BWDB	High
certain areas because of low	15, 16, 17, 20,	Children	Low
coverage, impacting health.	21, pockets of	Elderly	Low
Increased temperatures and	the city in	Residents	Low
sewerage flow and discharge	are also	DPHE	Medium
in the nearby rivers, thereby impacting health of downstream people	vulnerable	Slum Dwellers	Low
	to impacts on skin of animals caused by climate change. Women will be the most impacted since agriculture is done mostly by women. Sudden increases in rainfall will impact drainage of certain areas because of low coverage, impacting health. Increased temperatures and irregular rainfall can impact sewerage flow and discharge in the nearby rivers, thereby impacting health of downstream people.	Commune of high potential in the nearby rivers, therebyIn the nearby rivers, therebyto impact of high potential in the nearby rivers, therebyvulnerableto impact of high potential in the nearby rivers, therebyvulnerablewill impact of high potential in the nearby rivers, therebyWards – 4, 5, 0, 7, 9, 13, 14, 0, 21, pockets ofinthe nearby rivers, therebyin other wardsimpacting healthare alsovulnerablevulnerable	toimpacts on skin of animals caused by climate change. Women will be the most impacted since agriculture is done mostly by women.Women Street VendorsSudden increases in rainfall will impact drainage of certain areas because of low impacting health.Wards – 4, 5, (5, 7, 9, 13, 14, DRWDBMunicipalityCoverage, impacting health. irregular rainfall can impact in the nearby rivers, thereby impacting health of downstream people.21, pockets of other wards are alsoDPHESlum DwellersSlum Dwellers

6.4 Adaptive Capacity of Fragile Urban Systems

The adaptive capacities of the four fragile urban systems were assessed during the SLD against the five parameters of economy, technology, governance, societal and ecosystem services. The municipality has access to some funds for taking up work on the various urban systems and also has the support of citizens. There is political stability and policies are in place for most of the urban systems and adaptive capacity varies between medium to high in this regard. However, there is need to build technological and economic support to the systems to increase their adaptive capacity. Water supply and economy are dependent on ecosystems and have high adaptive capacity in this regard. Drainage and sewerage has low adaptive capacity in the context of ecosystems.

Table 6 provides details of the vulnerability analysis of the fragile systems in Kushtia.

Table 6: Consolidated vulnerability analysis of Fragile Urban Systems identified for Kushtia city

Fragila Urban	Climate Fragility Statements	Vulnerable Areas	Urban Actors		Adaptive Capacity of the System		
System			Vulnerable	Potential Supporting	Low	Medium	High
Water Supply	Increasing temperatures	Wards - 1, 2,	- Slum	- Municipality		Economic	 Governance
System and	and irregular rainfall will	3, 7, 10, 13,	Dwellers	- DPHE		 Technological 	 Societal
River System	create greater demand for	14, 15, 16	- Residents	- BWDB			 Ecosystem
Management	water and put the system		- Farmers				Services
	under stress. This will		- Fishermen				
	impact municipal finances		- Women				
	and human health.						
	Water level of river needs						
	to be improved and will						
	be impacted further due						
	to high temperatures and						
	irregular rainfall, having						
	impacts on transport,						
	water supply and thereby						
	economy and health.						
Health System	Increasing temperatures	1, 2, 3, 6, 10,	- Children	- Municipality		• Economic	Governance
	and irregular rainfall will	13, 17, 18,	- Daily	- DPHE		 Technological 	 Societal
	increase the incidence of	20, 21	Labourer	- Civil Surgeon			
	heat strokes and		- Rickshaw	Office			
	diarrhoea that cannot be		Pullers				
	tackled by the inadequate		- Elderly				
health facilities available							
	in the city.						
Economy	Irregular rainfall will	Wards - 13,	- Farmers	- Municipality		• Economic	• Ecosystem

Fragile Urban Climate Fragility		Vulnorable	Urban Actors		Adaptive Capacity of the System		
System	Statements	Areas	Vulnerable	Potential Supporting	Low	Medium	High
	impact crop cycles, fishery	14, 15, 16,	- Daily	- Businessmen		• Technological	Services
	and fruit production by	17, 20, 21	Labourer			 Governance 	
	impacting the pest life		- Fishermen			 Societal 	
	cycle. Leather industry will		- Women				
	be impacted due to		- Street				
	impacts on skin of animals		Vendors				
	caused by climate change.		- Livestock				
	Women will be the most		rearers				
	impacted since agriculture						
	is done mostly by women.						
Drainage and	Sudden increases in	Wards – 4, 5,	- Children	- Municipality	 Ecosystem 	Economic	• Governance
Sewerage	rainfall will impact	6, 7, 9, 13,	- Elderly	- Water Board	Services	 Technological 	 Societal
	drainage of certain areas	14, 15, 16,	- Residents	(BWDB)			
	because of low coverage,	17, 20, 21,	- Slum	- DPHE			
	impacting health.	pockets of	dwellers				
	Increased temperatures	the city in					
	and irregular rainfall can	other wards					
	impact sewerage flow and	are also					
	discharge in the nearby	vulnerable					
	rivers, thereby impacting						
	health of downstream						
	people.						

7. **RESILIENCE INTERVENTIONS**

Possible adaptation interventions were identified for the five fragile urban systems in Kushtia on the basis of their climate risks and vulnerabilities, the vulnerable areas and the vulnerable actors to adapt to the possible impacts of climate change on these systems. Once the interventions were determined, their resilience score was calculated as high, medium, average and low on the basis of their resilience potential assessed in terms of their redundancy, flexibility, responsiveness and ability to increase access to information. If the interventions improved only one indicator mentioned above, their score was low, if they addressed two, their score was average, if they addressed three, their score was medium and if they addressed all four, their score was high. The climate resilience interventions were also assessed qualitatively for their technical, financial and political feasibility. The overall feasibility was calculated as an average of the qualitative feasibility for all three indicators. Finally their impact on the overall resilience of the city (short, medium or long term) was considered to assess the average time taken for the impacts to be felt on the resilience of the city.

These interventions were linked to existing city plans and schemes so as to determine whether the required interventions can be integrated with little or no additional resources into existing departmental programs or projects.

A total of 20 resilience interventions have been identified in the process as listed in **Table 7.** The interventions are grouped by fragile urban system and as infrastructural or non-infrastructural measures. The overall resilience score, overall feasibility and impact on the resilience of the city is given in the table. The table also gives an indicative duration for implementing the intervention as short (0-3 years needed), medium (3-5 years needed) or long term (more than 5 years needed) and an indicative cost requirement for the intervention as high (requiring substantial financial support), medium (requiring partial financial support) or low (can be covered by city budget). Each intervention's possible co-benefits are also outlined in the table.

Table 7: Prioritised Resilience Interventions against Resilience Indicators

Prioritised Resilience Interventions	Overall Resilience score	Overall Feasibility	Time taken for Impact on Resilience of City	Duration of Implementation Short/ Medium/ Long term	Indicative Cost (Low/ Medium/ High)	Potential Co- benefits
Water Supply System and River Syst	em Manageme	ent	-		1	l
Policy/ Non-Infrastructural Measure	S					
Awareness campaigns on water conservation, the importance of rain water harvesting and maximizing water-use efficiency in the home. It can be done by specialists for local government staff and then local government will campaign with the other stakeholders within the city.	High	High	Long term	Short	Low	Can be useful for awareness raising of other systems
Infrastructural Measures	1	1	I	1	1	1
Rain Water Harvesting - Implementation of a rainwater harvesting program for the storage of rainwater in surface (public) ponds/tanks and recharging ground water where appropriate. The Municipality can also encourage citizens to apply this rainwater harvesting program in their building rooftops for both potable and non- potable usage.	Medium	High	Long term	Medium	Medium	Improves soil conditions, green cover

Prioritised Resilience Interventions	Overall Resilience score	Overall Feasibility	Time taken for Impact on Resilience of	Duration of Implementation Short/ Medium/	Indicative Cost (Low/ Medium/ High)	Potential Co- benefits
			City	Long term		
Metering – Slab wise rating for	Average	Medium	Long term	Medium	High	Can help in
every connection needs to be						inculcating habits
established						of conserving
						water
Establishment of a surface water	High	Medium	Short term	Medium	High	Improvement of
treatment facility.						nealth of citizens
Conservation of existing water	High	Medium	Long term	Short	Medium	Improve green
bodies						cover, soll
Decular dradging of river hade by	Average	Madium	Madium tarm	Chart	lliah	conditions
the control government	Average	Iviedium-	Medium term	SHOL		
		10 w				
Drainage and Sewerage						
Folicy/ Non-Infrastructural Measure	5	11:-h	Lawatawa	Chart	1	Con
illegal connection of contic tanks				SHOL	LOW	can generate
with drains						nevenue unrough
Awarapass building among the	High	High	Longtorm	Shart	Low	Cap be used for
citizans (childron woman maids	півіі			511011	LOW	
slums) with regard to on site						generation of
segregation of their waste						other systems
composting plastic recycling						
disposal of waste in drains.						
Training of staff responsible for	Medium	High	Long term	Short	Medium	Better SWM can
managing solid waste on safety						lead to
procedures, scientific management						improvements in

Prioritised Resilience Interventions	Overall Resilience score	Overall Feasibility	Time taken for Impact on Resilience of City	Duration of Implementation Short/ Medium/ Long term	Indicative Cost (Low/ Medium/ High)	Potential Co- benefits
of waste and so on.						flow in drains
Municipality must ensure that soak	Medium	High	Long term	Long	High	Improved health
wells be built with every septic						
tank. This can be linked with						
building permissions and penalties.						
Infrastructural Measures	·	•		·	·	·
Augmentation of drainage	Medium	High	Long term	Medium	High	Improved health
infrastructure to cover water						
logged areas						
Regular maintenance of drains	Average	Medium	Long term	Short	Medium	Improved health
Development of a scientific waste	High	High	Long term	Medium	High	Improved health,
collection mechanism where						drainage
segregation at source is practiced.						
The municipality is producing	High	High	Medium term	Medium	High	Supplementary
compost fertilizer in its compost						income
plant through a box-composting						opportunities,
system. Co-composting can be						material recovery
introduced to deal with faecal						
sludge. It is a process by which						
biodegradable waste is biologically						
decomposed under controlled						
conditions by microorganisms						
(mainly bacteria and fungi) under						
aerobic and thermophilic condition.						
Faecal sludge can be treated using						

Prioritised Resilience Interventions	Overall Resilience score	Overall Feasibility	Time taken for Impact on Resilience of	Duration of Implementation Short/ Medium/	Indicative Cost (Low/ Medium/ High)	Potential Co- benefits
this math ad			City	Long term		
Policy/Non Infrastructural Macaura	•					
Policy/ Non-Intrastructural Weasure	5	111.1	1 1		1.1.1.	Constant database
Coordination needs to be built	Hign	Hign	Long term	Medium	Hign	Create database
between central government						for future
departments and research						planning
institutes to study the impacts of						
climate change on agriculture and						
livestock and build regional level						
plans.						
Vocational training for women and	High	High	Long term	Short	Medium	
men to diversify from traditional						
means of livelihood based on						
farming and fishery.						
Health System						
Policy/ Non-Infrastructural Measure	s					
Assessment of health risks with	High	High	Short term	Short	Medium	Create database
support from subject matter						for future
experts and health department						planning
Infrastructural Measures						
Increase the number of primary	Average	High	Short term	Short	High	Can serve as
health care centres.						awareness
						generation
						centres
Joint-venture of the central and	Medium	High	Short term	Short	High	

Prioritised Resilience Interventions	Overall Resilience score	Overall Feasibility	Time taken for Impact on Resilience of City	Duration of Implementation Short/ Medium/ Long term	Indicative Cost (Low/ Medium/ High)	Potential Co- benefits
local government in providing health facilities.						
Increasing the number of beds in government hospitals.	Average	High	Long term	Medium	High	

7.1 Integration into city plans

The following are the ongoing projects in Kushtia Municipality²⁵

S. No	Project	Details				
1	Urban	The project aims to improve the living conditions of three million				
	Partnerships for	urban poor in 23 cities and towns in Bangladesh of which Kushtia				
	Poverty	is one. The main focus of the programme is on 1. Mobilizing				
	Reduction Project	urban poor communities to form representative and inclusive				
	(UPPRP)	subgroups and prepare community action plans 2. Enabling				
		urban poor and extremely poor people to acquire the resources,				
		knowledge and skills to increase their incomes and assets 3.				
		Enabling poor urban communities to create healthy and secure				
		living environments 4. Fostering partnerships at the local and				
		national-level to influence pro-poor policies and practices				
2	Urban Primary	The goal of the project is to improve the health status of the				
	Health Care	urban population, especially the poor, through improved access				
	Project (UPHCP)	to and utilization of efficient, effective and sustainable Primary				
		Health Care (PHC) Services.				
3	Second Urban	Funded by the Asian Development Bank, the project aims at				
	Governance and	augmentation of urban infrastructure of systems such as water				
	Infrastructure	supply, sanitation, solid waste management, drainage,				
	Improvement	transportation and public use facilities.				
	Project (UGIIP-2)					

The resilience interventions identified in the CRS can be implemented by linking them to these projects that can be useful for both infrastructure programs and for building soft skills for the various fragile urban systems that have been identified.

A summary of the issues, climate impacts, vulnerable areas and resilience actions sector-wise is given below.

	 Sole reliance on ground water 					
Issues	 Increasing demand of water 					
155025.	 Iron pollution of water 					
	Water level in river is changing					
Potential Climate Impacts:	Increasing temperatures and irregular rainfall will create					
	greater demand for water and put the system under stress.					
	This will impact municipal finances and human health.					
	Water level of river needs to be improved and will be					
	impacted further due to high temperatures and irregular					

7.1.1 Water Supply and River System Management

²⁵ http://www.kushtiamunicipality.org/Ongoing%20Projects.html

	rainfall, having impacts on	transport, water supply and				
	thereby economy and health.					
Potentially Impacted Areas:	Wards - 1, 2, 3, 7, 10, 13, 14, 15, 16					
Risk Status:	Extreme					
Actors:	Vulnerable - Slum Dwellers - Residents - Farmers	Supporting - Municipality - DPHE - BWDB				
	- Fishermen - Women					

Prioritized Actions

Type of Measures	Cost per unit and description	Cost Estimate
Policy and Institutional Measures		·
Awareness campaigns on water	IEC materials, printing costs,	USD 2500 per training
conservation, the importance of	meetings, trainings, logistics,	
rain water harvesting and	staff costs	
maximizing water efficiency in the		
home. It can be done by specialists		
for local government staff and then		
local government will campaign		
with the other stakeholders within		
the city.		
Infrastructural Measures		
Rain Water Harvesting - Rain Water	Civil costs, construction costs,	USD 10000 per unit
Harvesting - Implementation of a	labour, materials, staff costs,	
rainwater harvesting program for	meeting, training	
the storage of rainwater in surface		
(public) ponds/tanks and		
recharging ground water where		
appropriate. The Municipality can		
also encourage citizens to apply		
this rainwater harvesting program		
in their building rooftops for both		
potable and non-potable usage.		

7.1.2 Health

Issues:	 Inadequate facilities to cater to demand Limited facilities in government hospitals Urban poor cannot afford private treatment
Potential Climate Impacts:	Increasing temperatures and irregular rainfall will increase the incidence of heat strokes and diarrhoea that cannot be

	tackled by the inadequate health facilities available in the			
	city.			
Potentially Impacted Areas:	1, 2, 3, 6, 10, 13, 17, 18, 20, 21			
Risk Status:	Extreme			
Actors:	Vulnerable - Children - Daily Labourer - Rickshaw Pullers - Elderly	Supporting - Municipality - DPHE - Civil Surgeon Office -		

Prioritized Actions

Type of Measures	Cost per unit and description	Cost Estimate			
Policy and Institutional Measures					
Assessment of health risks with	Cost of consultants, report	USD 10000			
support from subject matter	preparation				
experts and health department					
Infrastructural Measures					
Increase the number of primary	Civil costs, construction costs,	USD 20000 per unit			
health care centres.	materials, staff costs, labour				

7.1.3 Economy

liques	• Primary sector dependence is high which is affected				
issues.	by climatic risks				
Potential Climate Impacts:	Irregular rainfall will impact crop cycles, fishery and fruit				
	production by impacting the p	est life cycle. Leather industry			
	will be impacted due to impa	cts on skin of animals caused			
	by climate change. Women w	ill be the most impacted since			
	agriculture is done mostly by w	vomen.			
Potentially Impacted Areas:	Wards - 13, 14, 15, 16, 17, 20,	21			
Risk Status:	High				
	Vulnerable	Supporting			
	- Farmers	- Municipality			
	- Daily Labourer	- Businessmen			
Actors:	- Fishermen				
	- Women				
	- Street Vendors				
	Street Vendors				

Prioritized Actions

Type of Measures	Cost per unit and description	Cost Estimate
Policy and Institutional Measures		
Vocational training for women and	Cost of trainings, meetings,	USD 5000 per training
men to diversify from traditional	logistics, staff costs, materials	for 20-25 people
means of livelihood based on		
farming and fishery.		

	 Poor coverage of drains 					
	• Open drains, with lit	tering get clogged and water				
	logging is common					
	 No treatment of sev 	vage, and septage leaks into				
Issues:	drains and rivers					
	Lack of infrastructure	at the household level				
	Poor civic sense					
	 Linking septic tanks with the second s	ith drains				
	River pollution					
Potential Climate Impacts:	Sudden increases in rainfall w	vill impact drainage of certain				
	areas because of low coverage, impacting health.					
	Increased temperatures and irregular rainfall can impact					
	sewerage flow and discharge in the nearby rivers, thereby					
	impacting health of downstream people.					
	Wards – 4, 5, 6, 7, 9, 13, 14,	15, 16, 17, 20, 21, pockets of				
Potentially Impacted Areas:	the city in other wards are also	o vulnerable				
Risk Status:	High					
	Vulnerable	Supporting				
	- Children	- Municipality				
Actors:	- Elderly	- Water Board				
	- Residents	(BWDB)				
	- Slum dwellers	- DPHE				

7.1.4 Drainage and Sewerage

Prioritized Actions

Type of Measures	Cost per unit and description	Total Cost (Lakh INR)	
Policy and Institutional Measures			
Training of staff responsible for	Cost of training materials,	USD 5000 per training	
managing solid waste on safety	staff costs, logistics	for 20-25 staff	
procedures, scientific management			
of waste and waste handling.			
Infrastructural Measures			
The municipality is producing	Sludge disposal trucks,	A detailed project	

Type of Measures	Cost per unit and description	Total Cost (Lakh INR)
compost fertilizer in its compost	construction costs, civil work	report needs to be
plant through a box-composting	costs, labour, materials,	prepared to assess
system. Co-composting can be	training, meeting	costs
introduced to deal with faecal		
sludge. It is a process by which		
biodegradable waste is biologically		
decomposed under controlled		
conditions by microorganisms		
(mainly bacteria and fungi) under		
aerobic and thermophilic		
condition. Faecal sludge can be		
treated using this method.		

8. CONCLUSION

The implementation of the IAP toolkit in the city of Kushtia revealed that the city is very vulnerable to projected climate change impacts of higher temperatures and irregular rainfall. The city needs to adapt to possible impacts of the same. The economy is largely agrarian and basic urban services are unsustainable in the city. Therefore the city has a greater need to adapt to climatic changes that may be faced by the already fragile urban systems. The ICLEI ACCCRN Process helped identify five urban systems as fragile and climate fragility statements were formulated for all of them corresponding to the two climate scenarios. Transportation was later dropped from subsequent analyses as it received a medium score during the risk assessment.

The vulnerability map of the city shows wards 13, 14, 15 and 16 as the vulnerable hotspots in the city. These wards are closer to the river banks and house large urban poor populations and lack basic infrastructure. The remaining wards in the city are also impacted by 2 or more fragile systems. Kushtia Municipality itself is rated high on adaptive capacity in all the systems in terms of their capacity to organize and respond to threat or disruption, access to resources necessary for response (manpower, technology, funds) and access to information necessary to develop effective plans and actions and to improve responses to disruptions. The Department of Public Health & Engineering (DPHE) has medium adaptive capacity its responsibility is restricted to water resources management for the city, and because of low level of communication and integrated action by the municipality and the department, effective resilience building measures cannot be undertaken. Residents, farmers, fishermen, women, children and elderly have low adaptive capacity, with limited financial and technical resources and access to information.

The list of interventions identified in this CRS includes both hard and soft measures. These measures either directly or indirectly contribute to climate change adaptation while making the city more resilient. The finances required for implementation of the interventions can be obtained through assessment of the existing financial statements, existing projects, other national schemes, and also international programs. Kushtia Municipality and other implementing agencies can pick projects according to their priority and need within a specific fragile urban

system as well as the different climate scenarios agreed upon during initial stages of IAP. Integration of all prioritised interventions into other plans of the city is also important in order to avoid duplicity of efforts and enhance coordination. The way forward for the city to build resilience includes:

- Capacity building of staff: Staff needs training regarding management of waste since this is also related to sewerage and drainage in the city, and is also directly related to improvement of health of citizens.
- Infrastructure development: water supply systems, solid waste management systems, drainage, septage management facilities need to be established in the city to improve the resilience of these systems.
- Awareness generation: Citizens engagement and awareness generation activities are essential to increase the acceptance of municipal reforms. Several legal provisions need to be applied in a better and effective manner to improve the situation of the urban systems in the city, for example, decoupling sewage pipes from drains.

It is essential for the municipality to start collaboration with different agencies to build their technical capacity to undertake resilience building projects in the city. Planning in advance can not only help to avoid future threats but also provide opportunities to better social, economic and environmental development in the city.

Annexure 1

Urban Systems Analysis

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement	Climate Fragility Statement
Water Supply	Flexibility & Diversity:	Water level is going down,		Water supply system is	Increasing temperatures
System	Only ground water is	demand is increasing due		fragile because only ground	and irregular rainfall will
	used for water supply.	to irregular rainfall and		water serves as source of	create greater demand of
	River water level is	high temperature. As		water in the city and	water and put the system
	reducing due to less	demand is increasing,		lowering level of ground	under stress. This will
	rainfall	treated water (where iron		water will lead to greater	impact municipal finances
	Redundancy: water level	is removed) and filtered		water stress. This needs to	and human health.
	going down, leading to	water (with iron) is being		be addressed by RWH and	Water level of river needs
	more boring and more	mixed and supplied to		River water use.	to be improved and will be
	pumping of water. 3	citizens to need demand.		River is drying up and is	impacted further due to
	treatment plants are			impacting the existing	high temperatures and
	available.			ground water level, thereby	irregular rainfall, impacts
				impacting water supply	transport, water supply and
				system.	thereby economy and
					health.

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement	Climate Fragility Statement
	urban health care centre - 3 big, several satellite; municipal hospital; free service is provided to urban poor; facilities are not equipped to deal with climate change	because of high temperature and less rainfall - more heat strokes and diarrhoea is seen.		fragile because of inadequate facilities available, that cannot cope with the demand.	and irregular rainfall is causing heat strokes and diarrhoea, that cannot be tackled by the inadequate health facilities available in the city
	related health impacts <i>Redundancy:</i> Private hospitals are available, but unaffordable by urban poor				
Agriculture/Cr ops and Fruits/ Aquaculture or	Agriculture, fishery, livestock is heavily dependent on regular	changes in rainfall. Agriculture is typically done by women farmers, thus		agriculture, fishery, livestock that is impacted by climatic changes.	crop cycles, fishery and fruit production by impacting the pest life cycle. Leather
fishery/ leather industry/ livestock	seasonal cycles and is severely and erratically impacted by climatic change	exacerbating the impacts on women due to climate change. Fishery and livestock is also impacted		Industries such as leather industry is dependent on animals that are impacted by climate change	industry impacted due to impacts on skin of animals caused by climate change. Women most impacted
maintenance		by climate change. Leather industry is affected by decreasing quality of leather due to loss of hair			since agriculture is done mostly by women

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement	Climate Fragility Statement
		in animals due to excess			
		neat and lower rainfall.			
Drainage and	Flexibility & Diversity:	Impacted by seasonal		Poor coverage of the city	Sudden increases in rainfall
Sewerage	Coverage is poor and	changes in rainfall		and open drains in city get	impacts drainage of certain
	mostly open drains are	Impacted due to direct		clogged in excess rain.	areas because of low
	present in the city. These	linkage to Kali River which		Inadequate coverage of	coverage, impacting health.
	get clogged by litter and	is used for drinking or		septge management	Increased temperatures
	overflow in excessive	cooking		systems, leads of	and irregular rainfall can
	rain. Mostly septic tanks			overflowing and tendency	impact sewerage flow and
	that are emptied			of people to let the	discharge in the nearby
	regularly.			sewerage flow into the	rivers, thereby impacting
	Redundancy: If septic			rivers.	health of downstream
	tanks are not cleared				people.
	they are released into				
	open drains, causing				
	contamination of water.				
Transportation	Flexibility & Diversity:	225 km roads under		Roads are liable to breaking	Excess rainfall will break
	Less number of main	municipality that can get		due to excess rainfall.	roads and impact
	roads can impact	impacted by excess rainfall.			transportation in the city
	transport in the city.				

Annexure 2

Risk Scoring of Climate Fragility Statements of Urban Systems

Urban Systems	Climate fragility statement	Likelihood	Consequence	Risk Score	Risk Status
Water Supply system	Increasing temperatures and irregular rainfall will	5	4	20	Extreme
	create greater demand of water and put the system				
	under stress. This will impact municipal finances and				
	human health.				
River System	Water level of river needs to be improved and will be	5	5	25	Extreme
Management	impacted further due to high temperatures and				
	irregular rainfall, impacts transport, water supply and				
	thereby economy and health.				
Health system	Increasing temperatures and irregular rainfall is causing	5	4	20	Extreme
	heat strokes and diarrhoea, that cannot be tackled by				
	the inadequate health facilities available in the city				
Economy	Irregular rainfall will impact crop cycles, fishery and	4	3	12	High
	fruit production by impacting the pest life cycle. Leather				
	industry impacted due to impacts on skin of animals				
	caused by climate change. Women most impacted since				
	agriculture is done mostly by women.				
Drainage	Sudden increases in rainfall impacts drainage of certain	5	3	15	High
	areas because of low coverage, impacting health.				
Sewerage	Increased temperatures and irregular rainfall can	3	4	12	High
	impact sewerage flow and discharge in the nearby				
	rivers, thereby impacting health of downstream people.				
Transportation	Excess rainfall will break roads and impact	3	3	9	Medium
	transportation in the city				

Annexure 3

Scoring of Adaptive Capacity of Urban Actors

Actors	Capacity to respond (a)	Resources available (b)	Capacity to access information (c)	Adaptive capacity score (a*b*c)
Municipality	3	2	3	18
DPHE	1	3	3	9
Slum Dwellers	1	1	1	1
Residents	2	1	3	6
Farmers	1	1	3	3
Fishermen	1	1	3	3
Women	1	1	1	1
Children	1	1	1	1
Elderly	1	1	1	1
Daily Labour	1	1	3	3
Rickshaw Pullers	1	1	3	3
Street Vendors	1	1	3	3
Livestock Rearers	2	1	3	6
Water Board (BWDB)	3	3	3	27