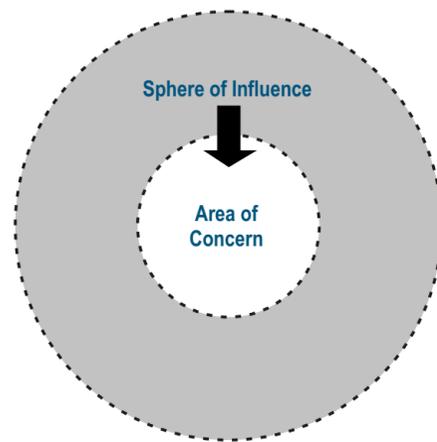


services, it was challenge to design method⁷ that well and truly represents entire city of Gorakhpur. Through rapid assessments and consultations with large population samples, preliminary survey inputs were collected. City was divided into 7 police zones. Survey findings were shared and discussed with representatives of 7 zones. Representatives were facilitated to identify and also prioritize severity of climate risks, its impacts and vulnerabilities of communities in their respective areas. Perception mapping done with people were cross-validated with municipal data of services in respective wards. Using Google imagery and GIS techniques, 30% households were identified by stratified sample method for detailed household surveys were carried to ascertain climate impacts at micro-level on municipal services and systems.

16 problems related to systems and services were identified in Gorakhpur which was further prioritized into 5 core systems and services and recommendation for initial intervention with the Municipal Corporation of Gorakhpur.

Resilience Strategy

Having identified and prioritized climate risks to systems and services and related vulnerability of communities, it was important to diagnose



causes behind systemic failures and/or malfunctions when put under climate stressed conditions. It was more important to ascertain and establish systemic behavior under projected climate conditions for Gorakhpur city in order for strategy to recommend and influence short and long term investments decisions of Municipal Corporation for infrastructure development. Climate change impacts in Gorakhpur have been broadly classified and put under three major causes. These are;

1. Natural causes
2. Behavioral causes of people who manage and use systems
3. Policy and political causes

The Approach

Approach towards city resilience is based on prudence of improving system efficiency through behavior change and performance improvement of people who manage systems and those who use. It works on principle of minimum demand for energy and investments together with high returns through public education and accountability measures.

Resilience strategy of city is aligned with approach and to inherent principles therein. It addresses sphere of influence that works more at behavior to influence areas of concerns e.g. natural and infrastructure systems. In regions of high rural-urban ratio, it makes sense to work more at level of sphere of influence than sphere of concern.

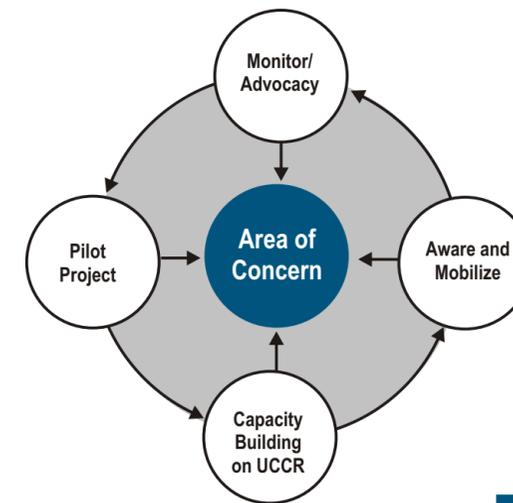
In Gorakhpur Water logging, Drainage, Solid waste, drinking water and sanitation services are hampered badly by climate change impacts. It is visualized that resilience could be built by addressing fragility of systems to climate change impacts by rendering improved access of communities to services and by quality implementation of rules and policies.

Major problems faced by residents of Gorakhpur due to climate change impacts have been put under seven groups each representing a sector.

Sector	Climate Change, Impacts and Vulnerability
Basic Services	Sanitation, hygiene, drainage and safe drinking water
Housing	Inundation, low cost house design for water logged situation
Industry	Industrial waste and pollution, safety at work place, housing for workers
Health	Seasonal outbreak of epidemic, preventive health, health surveillance
Energy/Electricity	Power failure and breakdowns, production/livelihoods, alternate energy
Transport	Efficient transport mechanism, vehicular emission
Ecosystem	Conservation of public and open areas, water bodies

City resilience building is an evolving and continuous process. Therefore, CRS would need periodic reviews by stakeholders for needed adjustments. Proposed resilience strategy is unique in sense that it attempts to build synergy at three different levels i.e. system, users and providers and governing rules and policies. In Gorakhpur, out of seven interlinked sectors, four sectors have been identified for pilot interventions.

Sectors like water, sanitation, drainage, housing, health and natural ecosystems are badly hampered under climate stressed conditions also are the most basic ones providing health, shelter and life to local populace. CRS has identified key actionable areas to build resilience of each sector in short and long terms.



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City Resilience Strategy

Summary





Introduction

End of twentieth and beginning of twenty first centuries witnessed to two unprecedented changes happening across the globe. First was unrolling of economic reforms that continue to shape economic growth of large number of developing countries¹. Akin with pace of economic growth is rapid growth of urban centers all over but more particularly in South-East Asian countries. Before it came to be realized such is the pace of economic change that almost 50% of world population has suddenly come to live in cities. India is no different and has observed 53.7% growth in number of towns in last decade². According to recent World Bank report³, India accounts for one-third of world poor⁴. It is implicit therefore that contrary to prevailing perceptions of poverty being endemic to villages in India, urban areas too are now home to millions of poor people. From where and why do poor people come to settle in urban areas, very often in most appalling subhuman living conditions is key question that needs serious thinking.

Parallel to global economic reforms but not necessarily consequence of it is growing concern of climate change. Climate being over arching phenomenon affecting every other function on earth, any significant change in climate has potential of affecting social, economic and political milieu of nations. Relation between economic growth and climate health is perhaps better understood in recent times than it was thought ever before. Government policies and development initiatives are more interested and inclined in favor of supporting sustainable models of economic growth and development. Climate impacts viz. floods, cyclone, draught and temperature whilst are increasingly becoming more devastating and frequent, beckons serious relooking and mainstreaming of into planning considerations of development projects. Quest for sustainable development and to button down problems of urbanization, economic growth and climate change is extensively pursued at various levels.

1 Asian Cities Climate Change Resilience Network- Aug 2012
 2 Ministry of Urban Development, Gol, January 2012
 3 World Bank Report 2013
 4 Less than 1.25 US\$ (about Rs. 65) per day
 5 Census India 2011
 6 Master Plan 2021 of Gorakhpur

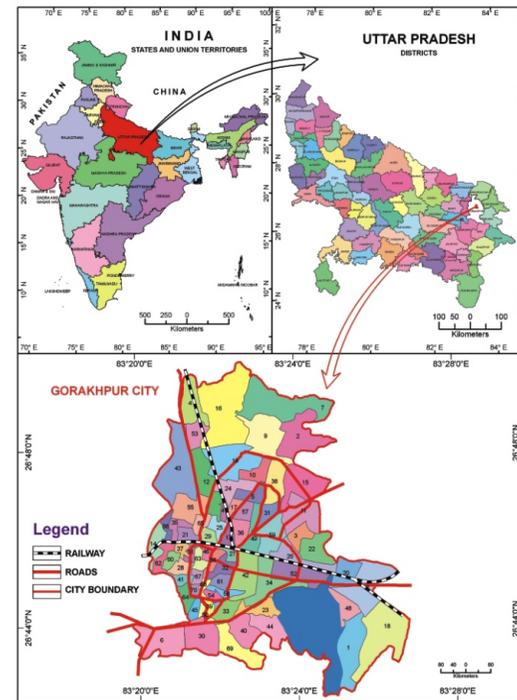
All said and done, what is visible more and more is shift in livelihoods of people from farm to non-farm based employment sectors. Development policies need to recognize and address current occupational shifts and make suitable corrections and adjustments, thereof.

City Resilience Strategy (CRS) is premised to address climate impact challenges faced by city systems and services offered to people. Strategy document has been conceived, designed and developed to test notion of resilience of a city made vulnerable to climate change impacts. Strategy document is enriched by first-hand experience of local people who have withstood many disasters by being at the center of it. Lessons drawn from other countries and important policy analyses go into making of present strategy document for its application by city managers. CR attempts to capture complexities of urban systems and suggests short to long-term interventions to build city resilience. Strategy chooses to empower local people and their institutions who it believes hold keys to process of building resilience of city.

The City

Gorakhpur is situated on banks of two major river systems, namely Rapti and Rohin. It is spread over 147 sq. km. area and located at height of 75-85 meters above mean sea level. Gorakhpur is unique to have large number of water bodies; biggest among all is Ramgarh Tal in south-east part of city. Proximity of city to Himalayan mountain range and location in tarai region, Gorakhpur has moderate climate with annual average temperature 25.68° C. Summer and winter temperatures however peaks to 31.95° C and 19.57° C respectively. City receives 119.2 cm of annual rainfall with maximum precipitation recorded in months of July to September.

Gorakhpur is one of the fastest growing cities of mid-Gangetic region. City is administered by 70 municipal wards having a total population⁵ of 692519 spread unevenly in city. Old wards of city have very high density of population. Population of Gorakhpur has increased rapidly with record growth of 64.1% during 1981-1991 due to expansion of city by incorporating 47 peripheral villages into municipal area⁶. Large number of



slums constitute roughly 33% of total population of city resides in 110 different locations with or without tenure rights.

The Context

In last couple of decades, Gorakhpur has been experiencing unprecedented problems of water logging in large areas of city causing loss of employment and physical damages to property. Health issues are grave concerns for the city and have been increasing in exponential terms with large number of deaths reported every year due to water and vector-borne diseases. Population growth and vehicular pollution have reached to levels which were never experienced before. There is fast depletion of open areas in city due to large scale unplanned construction all over.



Civic services are at the nadir, non-existent or at best exist in unhygienic and unusable state. City becomes virtual hell and unlivable during rains. Gorakhpur is fast turning to become a place where rains are NOT welcomed any more by large number of households.

In backdrop of humungous problem faced by city, crucial determinant for success for city resilience was to develop a method and approach that people and administration equally share and also willing to support. Method need to assess and establish climate risks to city and determine consequent vulnerability of communities. It meant designing participatory tools using which hydrogeology of city, climate variability and allied risks and vulnerability of people is put into perspective of development planning for overcoming challenges faced by people. In following sections, general outline of method and strategy formulation is explained.

Elements of Resilience Strategy Formulation

Strategy has looked into following essentials into making of resilient city:

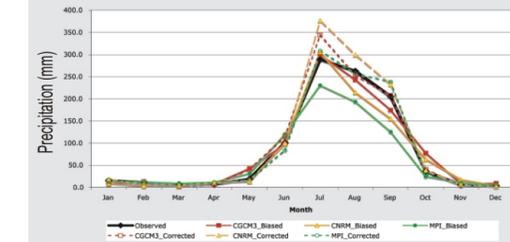
Understand historic climate trends and futuristic projection

Over hundred years of precipitation and temperature data is analyzed to understand historic climate events and trends. Similarly, temperature and precipitation projections of Gorakhpur city for years 2046 to 2065 is analyzed by running CGCM3, CNRM, MIUB and CSIRO climate models. Such analysis show maximum and minimum temperatures of Gorakhpur will increase and decrease respectively for maximum and minimum temperatures compared to past hundred years of climate.

Projection data shows increasing trend of maximum temperature for all four seasons. There is not enough model agreement over precipitation data. It might decrease in period from December to February and increase from March to May and later during September and October. Historic climate data however show that Gorakhpur is experiencing same amount of rainfall in less number of days, meaning thereby heavy to very heavy rainfall in shorter spells.



Gorakhpur A2 Future Mean Rainfall Scenarios : 2046-2065



Understand fragility of systems and services

It is important to understand people's access to system and service, what are the systems most impacted by climate change, why do systems and services become fragile, are these designed to withstand climate impacts and able to render services even when stressed, have systems

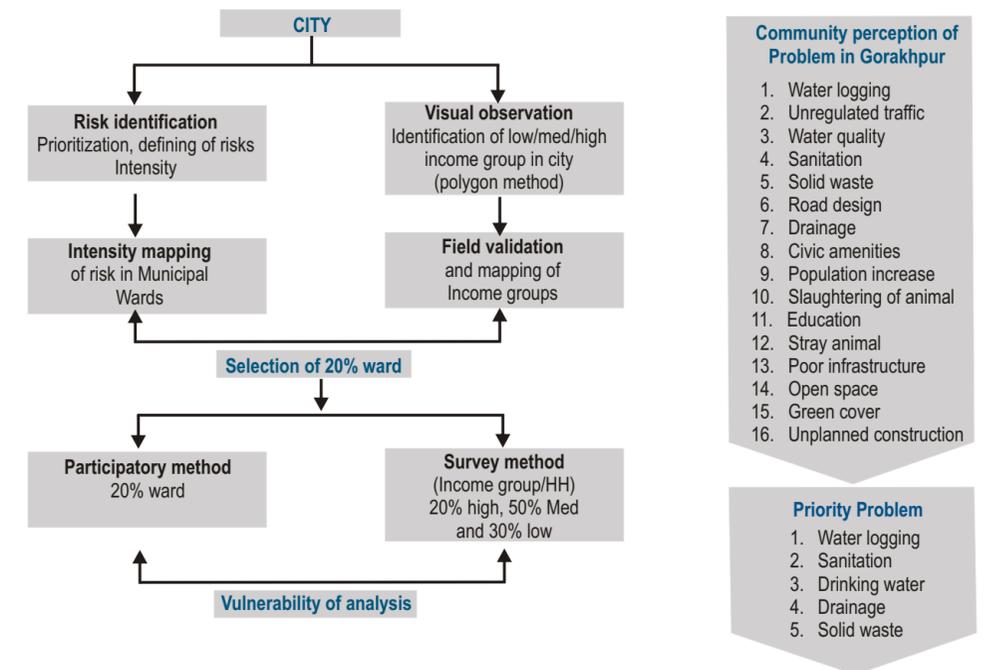
been designed after taking climate projections into consideration, what are roles and responsibilities of people who manage/use systems and how is one system linked and dependent on other systems and implications of failure of one over other systems.

Understand vulnerability and resilience options

How do people cope and manage when denied access or deprived of accessing system and its services, who are most vulnerable and why are they so, what could be done to build resilience of people, systems and thus of city on whole. Inputs from above three steps have been extensively used in designing of city resilience strategy.

The Method

Knowing well that climate impacts are harsh on vulnerable communities not properly protected or having safe access to infrastructures and



Community perception of Problem in Gorakhpur

1. Water logging
2. Unregulated traffic
3. Water quality
4. Sanitation
5. Solid waste
6. Road design
7. Drainage
8. Civic amenities
9. Population increase
10. Slaughtering of animal
11. Education
12. Stray animal
13. Poor infrastructure
14. Open space
15. Green cover
16. Unplanned construction

Priority Problem

1. Water logging
2. Sanitation
3. Drinking water
4. Drainage
5. Solid waste