
GORAKHPUR: A CASE STUDY OF RESILIENCY

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India with its immense geographic diversity faces **multidimensional** risks to climate change. Increased flooding, heavy storms and extreme weather events are affecting people's everyday life significantly. Statistics related to its devastating effects show how weak infrastructure and services magnify the impacts of extreme events for modern cities. Henceforth, Government of India, while envisioning '100 New Smart Cities' or 'Rejuvenation of 500 old cities' (AMRUT, 2015), does resiliency get priority? This research paper will try to investigate the nature of resiliency we should envisage through the case of Gorakhpur (one of the three pilot cities in India to have developed their resilience strategies under the ACCCRN network), because of country's rapid physical as well as climatic transformation, in order to assure **safety & sustenance** first for its people. The research enquiry will also showcase country's successful historical example (Varanasi, 3000 years old city located in Uttar Pradesh) of '**Flood Resiliency**'. A comparable context of both traditional & contemporary cities will capture a holistic scenario of **Indian planning history** in terms of acknowledging 'Resiliency' as a part of core city planning principles. Critical understanding of that transforming process will help to find out how contemporary inclusive resilient planning strategies can be framed for modern India.

Keywords

Multidimensional risks, Nature of Resiliency, Safety & Sustenance, Flood Resiliency, Indian planning history, Inclusive

How to Cite

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“URBANISM” IN INDIA

‘Imagine a world where we live within the limits of our environmental resources, where poverty is no longer an issue, where everyone has access to clean water, sanitation, sufficient food, decent shelter, and education – a world where everyone has a chance to prosper. Cities are often cited as the key to such a future, but only if we can create cities that are sustainable and resilient.’ (Visions of a Resilient City by ARUP)

So, how do we define ‘Urban Resilience’? It is “the ability of cities to tolerate alteration before reorganizing around a new set of structures and processes” (Alberti et al., 2003)

India with its immense geographic diversity faces multidimensional risks to climate change almost every year. Being the second most populous country with over 1.2 billion people¹, the humungous pressure of urbanization has been forcing people to grapple with issues like infrastructure deficits, ineffective urban planning and inadequate basic service provisions for a long time. As a consequence, every year cities are facing heavy loss of life and property due to climate-induced calamities.²

Urban centres in India are the new engines of economic growth and to assure their prosperous future, urban planners, policy makers, politicians along with ‘aam aadmi’³(common people) should be made concerned about their sustenance first. ‘Resilient cities in the light of climate change should be able to develop plans for future development and growth, bearing in mind the climate impacts that the urban systems are likely to face.’ (Prasad et al., 2009)

NEED FOR BEING “RESILIENT”

‘Within Asia, 24 percent of deaths due to disasters occur in India, on account of its size, population and vulnerability. Floods and high winds account for 60 percent of all disasters in India.’ (Tenth Five-Year Plan (2002-07) According to ‘India Today’ (September, 2015), the country has a strong history of getting affected by floods starting from ‘Bihar floods’ in 1987, ‘Maharashtra floods’ in 2005, ‘Assam floods’ in 2012, ‘Uttarakhand floods’ in 2013, ‘Jammu & Kashmir flash floods’ in 2014 & recently ‘Chennai flood’ in 2015. Out of total geographical area of 329 mha., more than 40 mha is flood prone. (Vulnerability atlas of India, BMTPC) According to the Census 2011 Report, 53 Indian cities have a population of more than a million and 25 of these are in the coastal states. Among the world’s top 10 in terms of population exposed to coastal flood hazard, two Indian cities, Mumbai and Kolkata, feature in the list. Statistics related to devastating flood-effects show how weak infrastructure and services magnify the impacts of extreme events for modern cities. According to NDMA⁴, the average annual flood damage during 1996-2005 was Rs.4745 crore, as compared to Rs.1805 crore, the corresponding average for last 53 years. (2008)



FIGURE 1 Flood in Indian Cities, 2015, People wade through flood waters in rain-hit Chennai

Urban development perspectives are expanding for India. According to TERI⁵, 31% of the current population in India resides in urban areas where as, by 2050, a billion people in India will live in cities.⁶ Henceforth, Government of India, while envisioning ‘100 New Smart Cities’ (2015) or ‘Rejuvenation of 500 old cities’ (AMRUT, 2015), does ‘resilience’ get priority? The present urban development policies generally do not consider/acknowledge the impact of climate change. According to TERI, around 70% of infrastructure⁷ in India is yet to be developed which is a huge opportunity for integrating climate resilience in future infrastructure development.

So, this research paper will try to investigate the nature of resiliency we should envisage through the case of Gorakhpur (a city located in Uttar Pradesh), because of country’s rapid physical as well as climatic transformation, in order to assure safety & sustenance first for its people. Inclusion of another comparable historical context (Varanasi) will help to capture a holistic scenario of Indian city-planning history in terms of acknowledging ‘Resiliency’ as a part of core city planning principles. Critical understanding of that transforming process will help to find out how contemporary **inclusive** resilient planning strategies can be framed for modern India.

PROCESS OF “RESILIENCE” TO “NEGLIGENCE”

Traditional cities were not planned. But they had the capacity to respond to its context more sensitively, which actually ensured their successful existence over the years. But, post-independence, the shift in contemporary planning process has helped enough to promote non-inclusive urban development across cities. As a consequence pre-dominantly urbanization process is struggling with communities in most vulnerable condition. So, they become prime victims of climate related calamities.

As far as the population growth is concerned, ‘Varanasi’ & ‘Gorakhpur’ are considered as two largest cities of Eastern Uttar Pradesh of India.⁸ (GEAG⁹, 2013) A brief introduction to their historical context along with process of transformation will be able to capture the process of ‘Decay’ for ‘Urban Resilience’ in India.



FIGURE 2 Communities with vulnerable condition, Gorakhpur City, 2013

HISTORICAL “EXISTENCE”: A CASE EXAMPLE OF VARANASI

Situated on the left (west) bank of the river Ganges in the Indian state of Uttar Pradesh, Varanasi has long been considered as one of the oldest surviving urban centres of Indian and world civilization (approximately 3000 years old). Irrespective of its historical religious importance, the city is famous for its majestic ghats along western bank of river.

‘Ghat’ is simply a set of wide steps leading down to the river which have become natural space of congregation, religious ceremony, and recreation. The steps function as a physical traversing device. But, this strategic interface of land and water were not built only to serve social/religious activities for people. A strong contextual understanding related to ‘topographical setting’ had encouraged to develop such physical ‘resilient’ strategies for traditional Indian cities.

Along the river Ganges a high ridge of kankar can be seen, extending almost continuously from one end of the city to the other interrupted only at ‘Dasaswamedha ghat’ by the ‘Godaulia nala’. This high ridge acts as a solid natural barrier protecting the city from the river. This limestone kankar naturally slopes down at the godaulia nala, acting as a natural drainage path for the city¹⁰. But, due to settlement’s existence along the ‘erosion edge’ of river, it was mandatory to encourage extra pre-cautions by stabilizing the crucial ‘land-water’ interface through physical development. As a response, strategic placement of high retaining dry-stone walls along with ghats acted as a structural protection for steep eroding banks.

Also the steps of the ghats allow the water from the Ganges to rise and as the seasons change and the water level goes down, the steps once covered by water slowly gets revealed. This designed historical interface actually acted as a protective buffer which helped habitation to respond towards natural forces (high tide and low tide) in a more adaptive/flexible way. In continuation to that, organically evolved city structure encouraged termination of all streets near these ‘ghats’, which eventually facilitated city’s natural drainage system with reference to existing topographical nature.

This explains very clearly, how historically cities have ensured their existence by adapting thoughtful contextual ‘flood resilient’ strategies where as contemporary example showcases a situation in contrast.

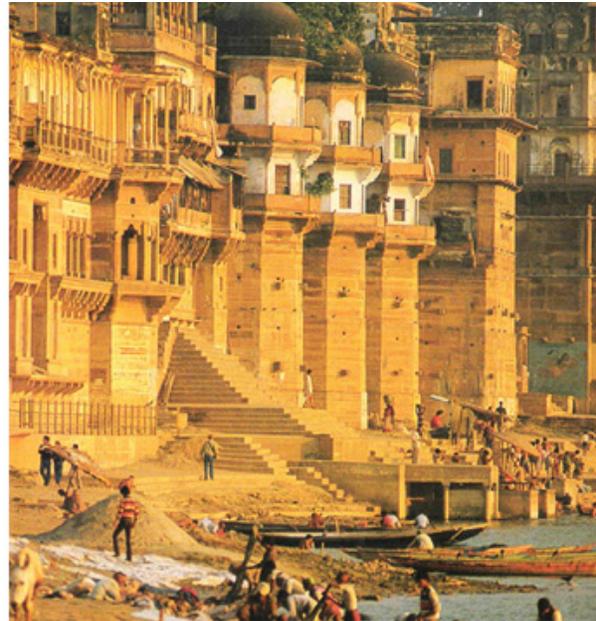


FIGURE 3 Traditional 'Resilient' interface of land & water at Varanasi

CONTEMPORARY "DECAY": A CASE EXAMPLE OF GORAKHPUR

Gorakhpur is located in the Terai belt of Eastern Uttar Pradesh, India. It is comprised of the districts of Basti, Deoria, Azamgarh and parts of Nepal Tarai. Historically, it had been an important centre of Aryan culture and civilization.

Due to its pleasant climate, British people developed it as mini hill station. The seed of urbanization was implanted with establishment of Northern Railway headquarters during 1970, which got transformed later into the largest commercial centre of the region having both retail and wholesale market ranging from agro-based products to home-based cottage industries.

During the last three decades, the population of the city has increased rapidly with a record of 64.1% growth during 1981-1991¹¹, which is a result of incorporation of 47 villages into the municipal area. The city has exerted tremendous pressure on its infrastructural capacity due to rapid influx of population from nearby rural areas. Hence, in present situation there are 110 slums accommodating approximately 33% of total population. (ibid: pg 13) The constant deterioration of living conditions has been affecting citizen for a long time.¹²

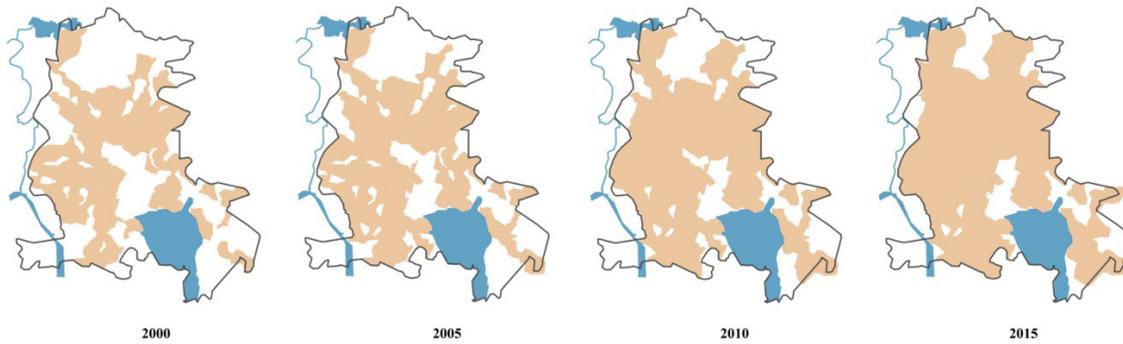


FIGURE 4 Gorakhpur growth pattern from 2000-2015

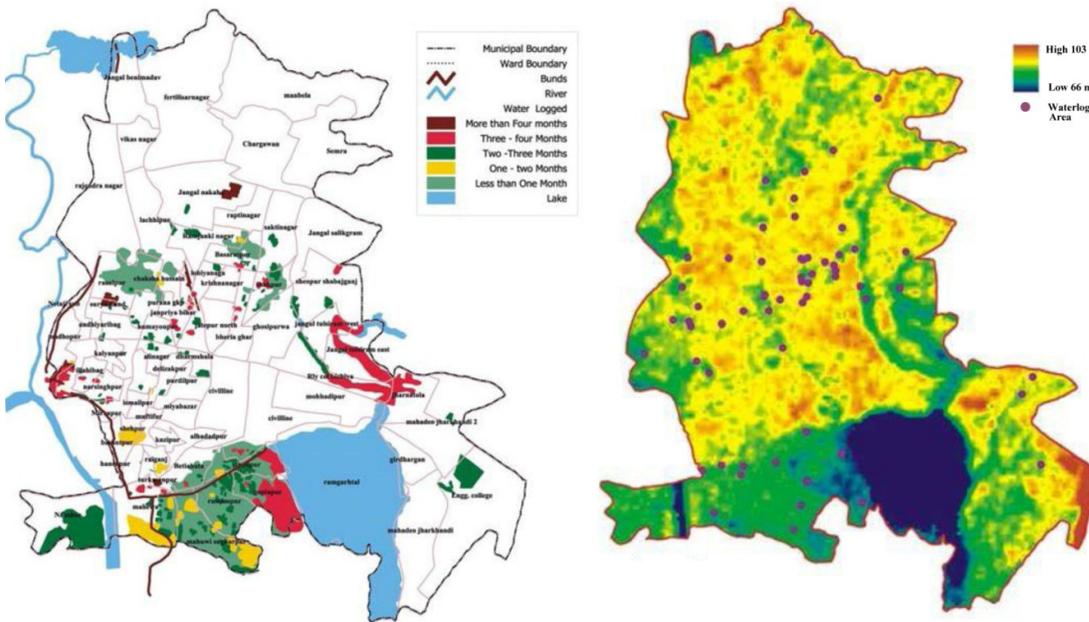


FIGURE 5 orakhpur Civty: Water-logging scenario

The city is naturally vulnerable due to its physical attributes. Due to the frequent meandering of the river Rapti in the past, the saucer shape topography of the city is badly affected. Some parts of south and south-east of the city go lower than the riverbank during monsoon season. Presently, 18 percent of city area especially the southern, western and central areas face acute water logging.

Nearly 70% of Gorakhpur's people are rural who sustain on Agriculture. These people are struggling with these climate related vulnerabilities years after years. But, the emerging context of pre-disaster, disaster and post-disaster periods is testing their toughness beyond their nerves. There are areas where water stagnates for more than three to four months, leading to adverse health conditions and increasing health hazards. After independence, lack of comprehensive planning approach, negligence towards ecological understanding has gifted city with enough haphazard non-resilient development leading towards extreme vulnerabilities. As a consequence, along with water logging, the city is also suffering from poor sanitation and solid waste management causing the unhygienic environment susceptible to water borne and vector borne diseases also.



FIGURE 6 Flood in Gorakhpur, 2009



FIGURE 7 Shared Learning Dialogues, Gorakhpur, 2013

Eventually, these are some crucial problems which most of contemporary Indian cities have been facing due to its constant negligence towards resilience. But, Gorakhpur district is already trading on this new path to create a safe and resilient future for its people. The Asian Cities Climate Change Resilience Network (ACCCRN), supported by the Rockefeller Foundation was launched in 2009 to create climate resilience strategies and action models in 10 cities across four countries in Asia. Gorakhpur was one of the three pilot cities in India to have developed their resilience strategies under the ACCCRN network. Multiple stakeholders joined hands with the city governments to develop resiliency strategies and identified pilot adoption projects for implementation.

“RESPONSE” TOWARDS “RESILIENCE”

Gorakhpur’s flood response-centric disaster management plan was failing to meet the crisis of erratic weather patterns. So, a dynamic group of institutions (GEAG, NIDM, ISET) joined hands with Gorakhpur Disaster Management Authority to demonstrate a fresh approach that integrated climate concerns into disaster management planning. ACCCRN developed a common ‘methodology’¹³ based on critical sectoral ‘assessment’, which ultimately helped to take necessary ‘Resilient Actions’.

“RESILIENT” METHODOLOGY

Shared learning dialogues were envisaged as a key step to engage a diverse group of people varying from scientific experts, local government officials, research centres, to civil society, private sector and community representatives through a process of knowledge sharing for identifying key priorities, needs and gaps in the cities. They have been designed to ‘facilitate mutual learning and joint problem-solving within a project city to understand the linkages between urban growth and development and climate change and vulnerability of people and sectors’ by incorporating open communication between various stakeholder groups. (ACCCRN, 2013).

In continuation to that, ‘Climate vulnerability assessments’ and detailed ‘Sector Studies’ on water, transport, sewage/drainage etc., provided a basis for all project cities to facilitate better understanding on how individuals, communities, and urban systems specific to their contextual background may get affected directly and indirectly by future climate impacts. Implementing partners along with local universities were involved to facilitate this study. As an outcome, ‘City Resilience Planning & Strategies’¹⁴ were formed which draws analytical conclusions from all previous stages and envisions city’s climate resilience in question through specific strategies.

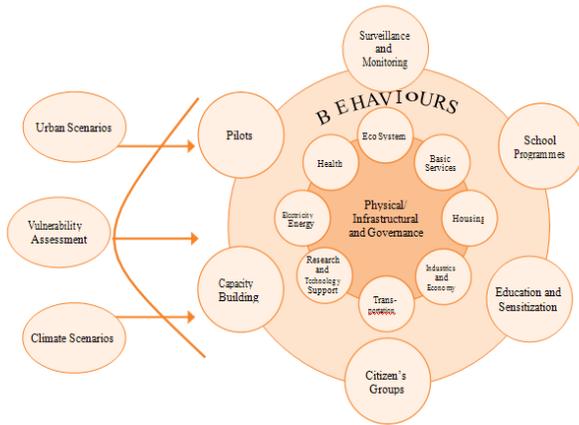


FIGURE 8 Methodology and Tools used for the vulnerability assessment in Gorakhpur, 2013

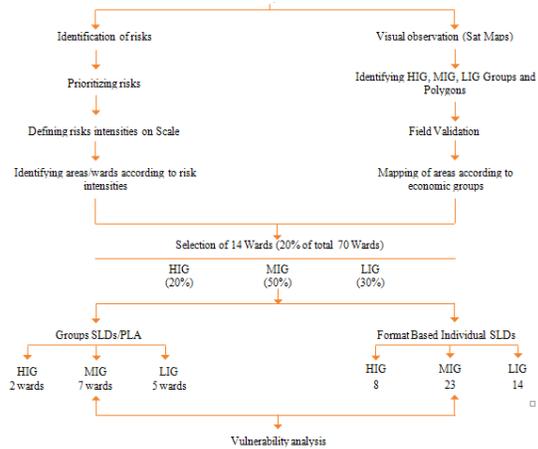


FIGURE 9 Gorakhpur Resilience Strategy Framework, 2013

“RISK” ASSESSMENT

A detailed assessment on various factors were done before preparing final ‘Risk Framework’. Pre-dominantly ‘Vulnerability’, ‘Urban Scenario’ and ‘Climate’ sectors were prioritized during this stage;¹⁵ Basic infrastructural services (e.g. roads, housing, drinking water, waste management, electricity, transportation and telecommunication) essentially ensure resilience of a community. Based on increasing risk of water logging in Gorakhpur, particularly for the unprivileged people, a study on ‘vulnerability’ has been done by GEAG based on the analysis of primary data collected through community and household questionnaires, participatory methodology tools and shared learning dialogues.

Development of city infrastructure is also not at par with the increasing demand due to uncontrolled influx of population growth. To address this severe issue, several SLDs were organized during ‘Urban Scenario assessment’ to include key stakeholders (e.g. personnel from the IMD, the Municipal Corporation of Gorakhpur, the Fisheries Department, Gorakhpur Development Authority, informed citizens and academics of the city) to find out key drivers of urban growth in future which were ultimately categorized into political, economic, social, technological, legal and environmental factors.

The city has become a witness of transforming weather events for last few years. Recalling the devastating flood scenarios of 2008 (high flood year in the recent past) through interviews of key stakeholders from various wards made it mandatory to conduct a detailed study on ‘climate change projection’ for Gorakhpur which showcased a substantial uncertainty with the time series of precipitation values. ‘It was seen that the minimum monthly totals, especially in the monsoon months, show an increase over corresponding values in the past, while the maximum monthly totals show a decrease.’(GEAG, 2013) Concerned authority relied more on the trends and changes in future precipitation patterns. The implications of such changes were discussed in an SLD focused on developing climate scenarios. The participants included personnel from the Indian Meteorological Department (IMD), the Irrigation Department of Uttar Pradesh, members from the ISET18 and the GEAG Team. From the discussions, it was deduced that the focus needs to be on addressing challenges associated with increased “wetness” during the monsoon months that could cause increased flooding. SLD also gave priorities to ‘another key consequence of increased wetness and increase in temperature was an increase in humidity in the monsoon months, which is likely to pose additional challenges to the health sector.’ (GEAG, 2013).

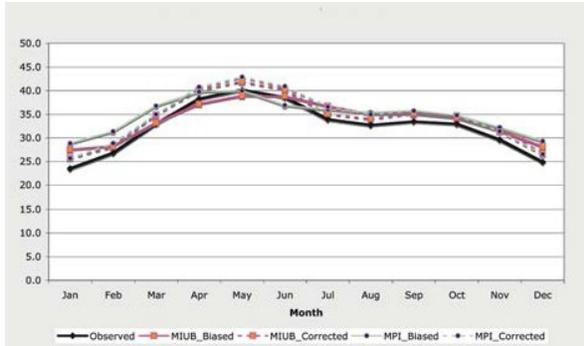


FIGURE 10 Gorakhpur City : Simulated future maximum temperatures (2046-65)¹⁶

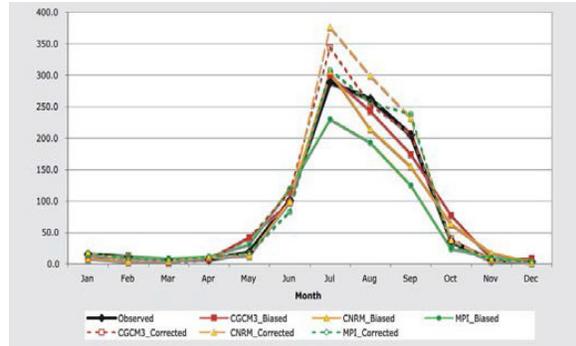


FIGURE 11 Gorakhpur City : Future rainfall scenario (2046-65)¹⁷

DEPARTMENT	GAPS IDENTIFIED	RECOMMENDATIONS TO DEPARTMENTS
Rural Development Distt. Administration	<ul style="list-style-type: none"> • Lack of adequate human resources • Lack of information on fund disbursement to the beneficiaries under the disaster relief fund • Non-utilisation of funds due to lack of information on disaster management relief fund 	<ul style="list-style-type: none"> • Development programmes should be designed keeping in mind the local disaster threats and disaster reduction should be an integral part of the development programmes. • Coordination between governmental planning and development projects should be established. • MGNREGA scheme should be utilised for cleaning of rivers and removal of silt. Several other developmental works can be done through MGNREGA funds.
Health Department	<ul style="list-style-type: none"> • Connecting road to PHCs/CHCs gets damaged during rainy season. Long duration power cuts creates problems in attending the patients in the PHCs/CHCs. • Women employees feel unsafe working in the late evening hours in the centres because there is no adequate arrangement of lights on the roads. • Caution before floods are not given due to which adequate preparation are not made. • Most of the health centres get waterlogged due to heavy rain. 	<ul style="list-style-type: none"> • In the construction of PHCs/CHCs, it is important to include flood resistant techniques along with earthquake resistant techniques. • Training on DO's and DON'T's at times of disaster should be organised for the members of Village Health and Sanitation Committee.
Education	<ul style="list-style-type: none"> • School premises is often used for shelter and relief centres during flood disaster. • Lack of knowledge in students regarding basic disaster preparedness and safety. • Many of the schools are not located at elevated land. 	<ul style="list-style-type: none"> • In the construction of schools, it is important to include flood-resistant techniques along with earthquake-resistant techniques. • Site selection for construction of schools should be done at a safe and elevated place. • Mock programmes in the schools should be organised on relief and management of disasters; the schools should not be used as disaster relief camps or for storage of food grains. This adversely affects education.

TABLE 1 Example of Department-wise identified gaps and recommendations

“RESILIENT” ACTION

The city has been suffering from ‘Waterlogging’, ‘Sewage & Sanitation’, and ‘solid waste’ pre-dominantly for a long time. An unique response-centric approach ultimately motivated both government and community to take up required ‘Resilient’ actions more efficiently.

NEW ROLE FOR GOVERNMENT

‘Shared learning dialogues is a process that brings together our technical knowledge on climate change and people’s wisdom be it frontline functionaries, district departments or even ordinary citizens. The solution that emerge from this convergence are effective and sustainable.’ - Shiraz Wajih, GEAG (Gorakhpur Environmental Action Group)

Each department of the district (Rural Development, Health, Education, Agriculture, Animal Husbandry, Jal Nigam, Panchayati Raj, Flood & Draining, Saryu Canal) that deals with disaster management came together to analyze city’s vulnerability under different climatic conditions. Guided by climate experts and local knowledge, they identified existing gaps in their planning process and came up with key areas of improvement. These revised departmental plans then converted into a forward looking ‘District Disaster Management Plan’ complete with a wide range of recommendations that would build the expected resilience.



FIGURE 12 Gorakhpur City : Citizens’ march for a better tomorrow



FIGURE 13 Skill building programs for women in Gorakhpur

ROLE OF COMMUNITY

While governments are still grasping reality of climate change, voluntary organizations on the ground have already started their job by raising awareness and building resilience. Sometimes, it is just a sms that can be a saviour like weekly forecast delivered to the local farmers by GEAG. Being at the forefront, local communities are the first responders to disasters. Under the grant of 13th Finance Commission, the Uttar Pradesh State Government is giving skills and resources to nearly 9000 vulnerable gram panchayats so that they can better prepare for disasters. The priority has been given to make community aware of certain disaster mitigation practices or response practices or relief practices through running different skill building programs in those vulnerable areas and the initial focus group is women. According to Aditi Umrao from Uttar Pradesh State Disaster Management Authority ¹⁸, 'in our community based program, we are involving more and more women only because they gave cascading effect to training programs or to the learning which they are given.'

Farmers have started reclaiming their autonomy over seeds. They run a seed bank that sells traditional and climate resilient seeds to fellow farmers. According to Ram Nivas, Chikni (farmer of Gorakhpur) 'If we grow robust crops, then no matter whatever disaster strikes, be it heavy rain or draught, it will survive. Like the millets which were grown 50 years back. They will give food security even if the rest of the crops are lost in disaster'. Small and marginal farmers have also adopted new techniques of farming and found themselves better prepared for erratic weather events. 'This has cow and buffalo dung, and some garbage. We have sealed it and left it to decay outside. Once it decays, it will turn into compost manure and can be used in the farm.' - Meghraj, farmer of Panchgawn, Gorakhpur



FIGURE 14 New climate responsive farmlands in Gorakhpur

Communities have also started adopting local strategies to make their habitation more safe and stable. Residents affected with flooding and stagnant water in their homes started encouraging new designs with a raised foundation (termed ‘corbelling’), which allows for excess water to flow beneath the structure. As, families may choose to stay with their homes during floods, developers added concrete shelves just below the ceiling so that valuables and food could be safely stored during high waters. Local knowledge has also introduced local material into resilient design and construction. (e.g. terra cotta roofing, bamboo etc.)



FIGURE 15 Construction of new homes designed with community inputs in Gorakhpur

RESILIENT “LEARNING”

Indian cities have been going through rapid urbanization through last few decades. But, development only becomes successful when their future has been secured. This paper has documented how ‘resiliency’ has been addressed diversely in different time-zones of ‘Indian planning history’. Historically, both cities (Varanasi & Gorakhpur) utilized their proximity to existing natural resource (river) as an asset for initiation of development. Case example of Varanasi further showcases how people have prioritized their safety by taking contextual precautions while building their habitation by optimizing future risk-factor. Whereas, case example of Gorakhpur showcases how planning policies have only encouraged ‘development’ after post-independence by neglecting its ‘context’. As a consequence, the failure of ‘demand-based approach’ have put future of city under risk. The change of climate has made its sustenance more vulnerable. So, can this situation be improved?

According to Prof. Anil Gupta from National Institute of Disaster Management, ‘We should focus on the underlying causes of risk- those factors that increase risk. When risk increases, then the form of disaster is bigger, the losses are more. We should address these risks through our development plans and these should link with our district disaster management plan. We should not wait for disaster to take action.’ Example of Gorakhpur city also showcases a successful case-study of a community in India that seeks to strengthen its institutions to address major challenges from nature and climate.

Developing resilience in the system and amongst people is a slow long term process. Henceforth, the evolving strategies which were framed for Gorakhpur city (as an outcome of ‘response-centric’ inter-disciplinary approach conducted by GEAG, NIDM, ISET along with ACCCRN network) will focus first on problems that are closely related to climate change and have a higher concern for the residents and city-managers. Later, those strategies will emphasize the development of capacity to address the technical, institutional, social, cultural and other dimensions. ‘To create a ripple effect that builds resilience over time in multiple arenas, the strategy will utilize targeted interventions that build knowledge, provide demonstrated examples, assist the development and build the capacity of organizations and creates pressure for change at behavioural, institutional and political levels.’¹⁹ To do so, the proposed resilient framework should have following foundations;

i) *Motivation & Drive*- At present, building urban climate resilience does not get encouraged by any policy at the national or state level which poses a challenge for the cities to initiate a process on their own. In the ACCCRN cities, the financial assistance from the Rockefeller Foundation and the technical assistance from the ACCCRN partners facilitated or ensured the city’s initial buy-in. So, motivational strategies should be taken care of.

ii) *Participatory Component*- The government of India has introduced the Community Participation Law (CPL) and made it mandatory as a reform under the JNNURM scheme. However, in reality, the culture of community participation is not popular here. So, to bring awareness, targeted physical and institutional actions has to be demonstrated directly which can address current and climate related problems at the local (ward) level while also building the social and institutional capacity to take action at that level. Resilience building strategies have showcased how response-centric participatory methodology can ensure sustainable future. Interdepartmental coordination is a mandatory for any climate resilience exercise. The resilience strategies are beyond administrative limits because of their inherent connection to geography, resources and their conservation, protection and management.

iii) *Capacity building & Institutionalisation* - The resilience-building process at the city level should be institutionalized through formation of a separate cell in the municipal corporation. The scope of pursuing the task would actually go beyond local urban bodies as we know, climate resilience have implications on various sectors like urban development, resource management, disaster management, environmental management and conservation. In fact to build the capacities of various stakeholders extensively, climate change should be introduced at the university level as one of the subjects for specialisation as a stepping stone to bring wide awareness.

A safe future is possible. The Gorakhpur experience of disaster management has been shared with all 600 plus districts of India through a training module developed by the National Institute of Disaster Management (NIDM). Will local governments in India embrace the path to its future? Only time can give that answer.

Acknowledgements

Authors are thankful to the **citizens of Gorakhpur city**- people who are struggling with vulnerable conditions for decades and still continues to have faith in achieving a better place to live for future. Their effort acted as prime inspiration for this paper. Once, Gandhi said: "Power resides in the people" and that is how 'Swaraj' described a mechanism to empower both 'people' & 'state' during independence. Authors showcased Gorakhpur's struggle for resiliency as a real life example to justify the validity of such utopian ideology in contemporary scenario after 68 years of independence.

Also, authors are grateful to the incredible effort **Rockefeller foundation** has been able to put to document and publicize this inspiring effort of **ACCCRN** and **ISET** for last few years to make people aware of 'Resiliency'. The paper has got maximum reference of its base framework from their publications only.

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Disclosure Statement

Authors declare that they have no relevant or material/ financial interests that relate to the research described in this paper. As per authors' knowledge, there is no such relationships/ conditions/ circumstances further that present a potential conflict of interest for any kind of readers. Authors do not possess any kind of patent (planned/ pending or issued) related to concerned work. In addition to that, the data has presented for purely academic purpose and does not violate any privacy rules for respective renowned sources which have been mentioned with proper acknowledgement at different places.

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Professor Suzanne Frasier, is an academic and design professional with over 20 years of experience in the design and construction industry prior to becoming a full-time Associate Professor at Morgan State University's School of Architecture and Planning, Baltimore. She has also been a faculty member at the New York School of Interior Design since 1988. She is the author of numerous theoretical and applied papers on architecture and design pedagogy, and sustainable consumption in urban developments. She was awarded Fullbright-Nehru Teaching and Research Fellowship in 2012 which she completed in affiliation SPA, New Delhi. She was an **advisor** for concerned research paper.

Endnotes

- 1 TERI, *Climate Proofing Indian Cities: A Policy Perspective*, March 2014, chap.1.
- 2 TERI, *Climate Proofing Indian Cities: A Policy Perspective*, March 2014, chap.2.
- 3 Shiraj A. Wajih et al., *Towards a Resilient Gorakhpur* (GEAG, ISET & Rockefeller Foundation, 2013), 05.
- 4 Rana P.B Singh, *Urban Planning of the Heritage City of Varanasi (India) and its role in Regional Development*.
- 5 A. Wajih et al., *Towards a Resilient Gorakhpur* (GEAG, ISET & Rockefeller Foundation, 2013), 06
- 6 Divya Sharma et al., *Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian Cities* (IIED: 2013), 19.
- 7 Divya Sharma et al., *Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian Cities* (IIED: 2013), 21.
- 8 Shiraj A. Wajih et al., *Towards a Resilient Gorakhpur* (GEAG, ISET & Rockefeller Foundation, 2013), 17-19.
- 9 Shiraj A. Wajih et al., *Towards a Resilient Gorakhpur* (GEAG, ISET & Rockefeller Foundation, 2013), 27.

Bibliography

- Anil K. Gupta et al., *Disaster & Development* (NIDM: 2013)
Divya Sharma et al., *Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian Cities* (IIED: 2013).
Gorakhpur Environmental Action Group(GEAG), *Rooting Resilience in Odds* (2013).
Rana P.B Singh, *Urban Planning of the Heritage City of Varanasi (India) and its role in Regional Development*.
Shiraj A. Wajih et al., *Towards a Resilient Gorakhpur* (GEAG, ISET & Rockefeller Foundation, 2013).
Stephen Tyler et al., *Developing Indicators of Urban Climate Resilience* (ISET: 2014).

Image Sources

- Figure 1: Indian Express, Digital Archive, <http://indianexpress.com/article/india/india-news-india/us-offers-assistance-for-chennai-flood-victims/>.
Figure 2: Gorakhpur Environmental Action Group(GEAG), *Rooting Resilience in Odds*, 06.
Figure 3: Illustrative diagram of river (source- author) & Photograph of Varanasi Ghats- Classical India, Digital Archive, <http://www.departuresandarrivals.travel/classical-india/>.
Figure 4: Illustrative diagram of city growth (source-author)
Figure 5, 06 & 07: GEAG Resource Centre, Digital Archive
Figure 8: Gorakhpur Environmental Action Group(GEAG), 2009: 3
Figure 9: Gorakhpur Environmental Action Group, Wajih et al., 2010: 23
Figure 10 & 11: Opitz-Stapleton, 2009
Figure 12: Amit Mitra, GEAG Resource Centre, Digital Archive
Figure 13, 14 & 15: GEAG Resource Centre, Digital Archive

Table Sources

- Table 01: NIDM, *Disaster & Development*, 2013: 22