RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

AFD
AGENCE FRANÇAISE DE DÉVELOPPEMENT

European Union

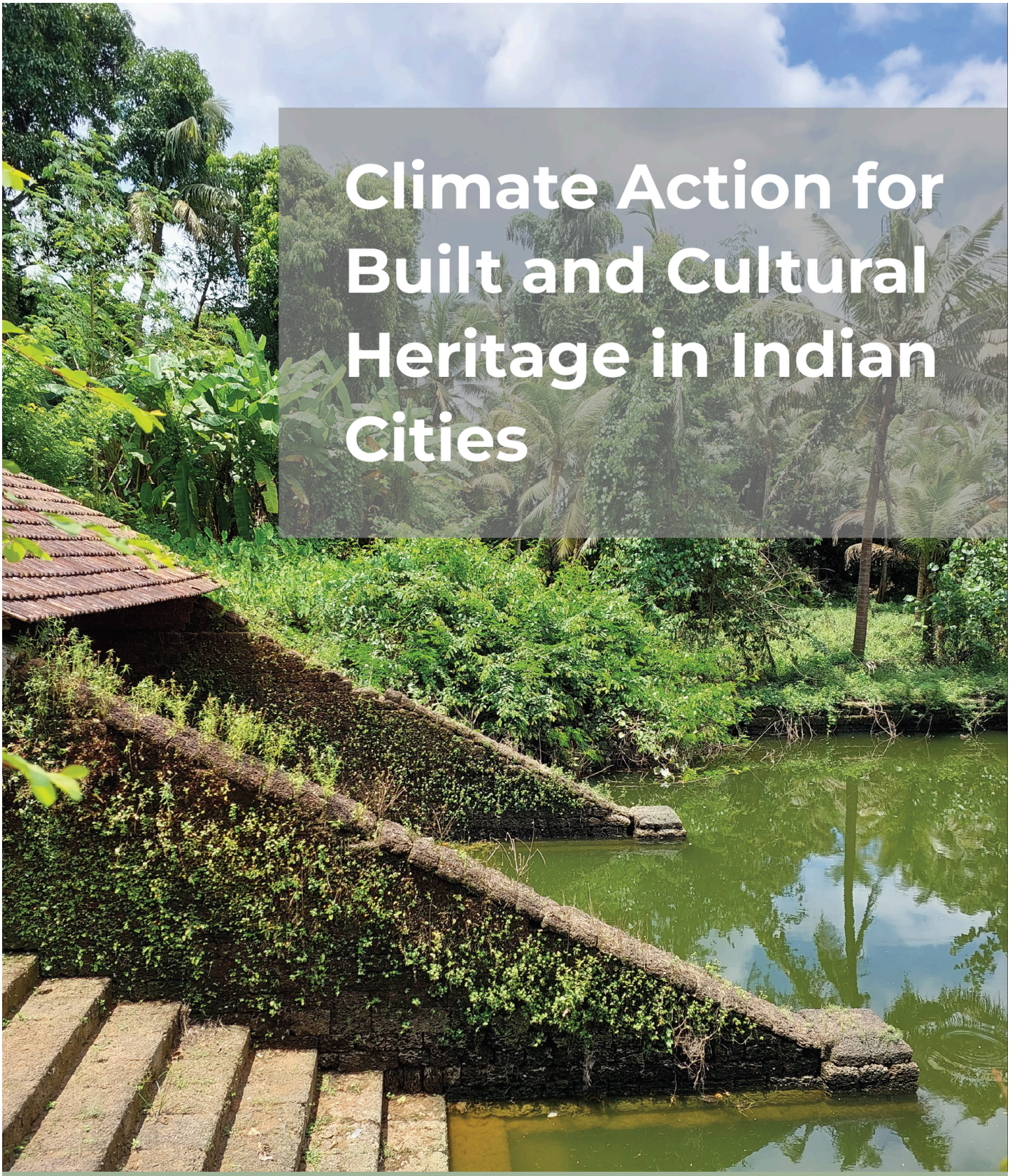
Global Gateway

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

Smart City
MISSION TRANSFORM NATION

National Institute of Urban Affairs

CITIIS
City Investments To Innovate, Integrate and Sustain



Climate Action for Built and Cultural Heritage in Indian Cities

A compendium of case studies capturing learnings on how cultural heritage can aid climate action

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Abbreviations

ABD- Area-Based Development
AECOM- AECOM Technology Corporation
AFD- Agence Française de Développement
AMRUT- Atal Mission for Rejuvenation and Urban Transformation
CAP- City Action Plan
CCAP- Climate Change Action Programme
CCFU- Climate Change Finance Unit
CCHWG- Climate Action Working Group
CCTV- Closed Circuit Television
CEPT- Centre for Environmental Planning and Technology
CHC- Center for Heritage Conservation
CHP- City HRIDAY Plan
CIDP- Civic Infrastructure Development Plan
CITIIS- City Investments to Innovate, Integrate and Sustain
CLAMC- City Level Advisory and Monitoring Committee
CMD- City Mission Directorate
CMP- CITIIS Management Platform
COP- Communication and Outreach Plan
COP26- Conference of the Parties 26
CPMU- City Project Monitoring Unit
CRCI- Cultural Resource Conservation Initiative
CRDF- CEPT Research and Development Foundation
CVI- Climate Vulnerability Index
DPR- Detailed Project Reports
DRM- Disaster Risk Management
ECV- Essential Climate Variable
E&M- Evaluation & Monitoring
ENSO- El Niño - Southern Oscillation
EPLCSIG- Executive Panel on Low Carbon Strategy for Inclusive Growth
ESMP- Environmental & Social Management Plan
E&S- Environmental & Social
EY- Ernst & Young
EU- European Union
FAO- Food and Agriculture Organization
GDP- Gross Domestic Product
GHG- Green House Gas
GIS- Geographic information system
HCA- Heritage City Anchors
HIA- Heritage Impact Assessments
HRIDAY- Heritage City Development and Augmentation Yojana
HUL- Historic Urban Landscape
ICCROM- International Centre for the Study of the Preservation and Restoration of Cultural Property
ICOMOS- International Council on Monuments and Sites
ICT- Information and Communication Technology
INDC- Intended Nationally Determined Contributions
IPCC- Intergovernmental Panel on Climate Change
IPFR- Implement Phase Final Report
IUCN- International Union for Conservation of Nature
JNNURM- Jawaharlal Nehru National Urban Renewal Mission
MoA- Ministry of Agriculture
MEA- Ministry of External Affairs
MoEF&CC- Ministry of Environment, Forests & Climate Change

MF- Ministry of Finance
M&E- Monitoring and evaluation
MoHUA- Ministry of Housing and Urban Affairs
MNRE- Ministry of New and Renewable Energy
MoP- Ministry of Power
MRTS- Mass Rapid Transit System
MST- Ministry of Science and Technology
MoWR- Ministry of Water Resources
NAPCC- National Action Plan on Climate Change
NGO- Non-governmental organization
NIUA- National Institute of Urban Affairs
NMEE- National Mission on Enhanced Energy Efficiency
NMGI- National Mission for a Green India
NMSA- National Mission on Sustainable Agriculture
NMSH- National Mission on Sustainable Habitat
NMSHE- National Mission on Sustaining the Himalayan Ecosystem
NMSKC- National Mission on Strategic knowledge for Climate Change
NPMU- National Project Monitoring Unit
NSM- National Solar Mission
NWM- National Water Mission
O&M- Operation & Maintenance
OUV- Outstanding Universal Value
PIB- Press Information Bureau
PIEVC- Public Infrastructure Engineering Vulnerability Committee
PLF- Project Logical Framework
PMU- Program Management Unit
PMC- Project Management Consultants
PPP- Public-Private Partnership
PPR- Project Progress Report
SAPCC- State Action Plan on Climate Change
SBM- Swachh Bharat Mission
SCM- Smart Cities Mission
SCP- Smart City Proposal
SDG- Sustainable Development Goals
SEP- Stakeholder Engagement Plan
SPV- Special Purpose Vehicle
STP- Sewage Treatment Plant
SWM- Solid Waste Management
TERI- The Energy and Resources Institute
UBDC- Upper Bari Doab Canal
UDC- Urban Design Collective
UGNLC- UNESCO Global Network of Learning Cities
ULB- Urban Local Bodies
UN- United Nations
UNCCD- United Nations Convention to Combat Desertification
UNDRR- United Nations Office for Disaster Risk Reduction
UNESCO- United Nations Educational, Scientific and Cultural Organization
UNFCCC- United Nations Framework Convention on Climate Change
UNISDR- United Nations International Strategy for Disaster Reduction Secretariat
UT- Union Territory
WH- World Heritage
WHITRAP- World Heritage Institute of Training and Research Asia and the Pacific Region
WMO- World Meteorological Organization
WHO- World Health Organization

Preface

Climate change and its intersection with cultural heritage can be viewed through two lenses. One is a preservation perspective that studies the impact of climate change on cultural heritage with the intention to preserve it. The questions which usually asked for that are: What are the climate change induced hazards and extreme weather events affecting the city and its cultural heritage? What are the levels of exposure of this heritage to hazards and what are the key vulnerabilities? What are the observed and potential impacts of these hazards on heritage? How do these hazards affect the intangible aspects of heritage by revealing their social, environmental and economic interdependencies? Are there any potential gradual impacts due to small shifts in temperature and humidity patterns?

In another way of understanding the interdependencies between climate change and cultural heritage, studies delve into the embodied advantages of cultural heritage. This perspective asks different questions. How can cultural heritage be a resource for climate action? Which communities hold the knowledge of traditional responses to climate related events and emergencies? In this context, how can heritage act as a resource for resilience of communities?

Human life and livelihood will always remain at the fore front of these conversations. In many cases, regardless of whether the community knowledge is harnessed or not, impacts of climate change manifest as loss of livelihoods, poor quality of life and health impacts. While responding to the question of preservation and resilience with respect to cultural heritage, these aspects must be at priority of any climate action.

Keeping all this in mind, international action on climate change and cultural heritage has worked with the principles of equity and spatial justice to suggest mitigation and adaptation measures. In some cases, climate action suggests addressing unavoidable loss through the tools of recording and documenting the knowledge. This compendium, without claiming to be exhaustive in its breadth or depth, collects examples of climate action for cultural heritage with the intention of creating a framework for historical cities in India. This works opens discourse that has so far not been studied for an Indian context.

Part A

Introduction

About the Project, Objectives of the Compendium

Climate Change and Cultural Heritage, Challenges for Indian Cities

National, State and City Action Plans

Learnings from Smart Cities Mission

Learnings from CITIIS Program

Learnings from HRIDAY Scheme

Existing Frameworks, Methodologies and Toolkits for Climate Change

Framework for Recording Case Studies

About the Project and Objectives of the Compendium

Indian sub-continent has varied geographical and climatic conditions, from the snow-capped mountains of the Himalayan range in the north to the coastal areas in the south with deserts and alluvial plains of mighty rivers in between. In the context of climate, regional geographic conditions and social economic aspects, the cultural resources of India are rich and varied. Amidst the challenges facing humankind and in spite of the threats to cultural heritage, there is an immense potential of cultural heritage to enable inclusive, transformative and just climate action, including through heightening the ambition and capacity of communities to act, supporting climate adaptation and resilience. Recognizing and responding to this situation, National Institute of Urban Affairs (NIUA), under its City Investment to Innovate, Integrate and Sustain (CITIIS) initiative has engaged a consortium consisting of Cultural Resource Conservation Initiative (CRCI), India Pvt Ltd; Center for Heritage Conservation, CEPT Research and Development Foundation (CHC, CRDF); and Urban Design Collective (UDC) to prepare a Climate Action for Built and Cultural Heritage in Indian Cities. Outcomes of this engagement are in three parts: a compendium of best practices in climate action for cultural heritage, framework and toolkit for climate action in Indian cities, and an e-learning module. This publication fulfills the first part of this engagement. The overall project is informed by two key questions: How does climate change affect cultural heritage? And how can cultural heritage be a resource for climate action.

The first section of this compendium gives a background of the project and lays out challenges of climate change upon the cultural heritage of the cities. It looks into existing frameworks of transformation of cities in India, such as Smart Cities, CITIIS and HRIDAY Programs in order to identity the ongoing actions on cultural heritage and consider possibilities of taking them further. This study would give an idea of the possible intersections between climate change and cultural heritage that can be viewed through developmental processes. This section also studies international frameworks and toolkits that may have lessons and parallels for Indian conditions.

Second and third sections of the compendium presents a collection set of relevant case studies from around the world and from India. In the second section, studies have been selected to present a diverse range of cases in terms of the following criteria: Geographic diversity, Diversity in terms of types of cultural heritage, Diversity in terms of climate vulnerabilities and Diversity in terms of climate action.

These case studies of climate action for cultural heritage are organized to cull out specific understanding related to Information and Advocacy, Demonstration Projects/ Proving by doing, Innovation and Social Enterprises (including participatory measures), Policy Regulations and Statutory Measures. This structures of organizing information about the case studies gives insights on the common lessons to be carried forward beyond their contextual attributes.

The same structure is carried forward in part three to present the discussion around case studies that were curated from a webinar organised on the subject. Webinar was introduced as a method to generate critical discussions around the scientific understanding and intuitive knowledge of the communities. To enable this, the webinar was introduced with a keynote presentation followed by two sessions. Each session had three speakers, one speaker that presented an international perspective or project and two speakers who presented their experiences of the Indian context. Each session ended with a panel discussion. The panel discussion highlighted the opportunities and challenges of climate action in heritage places and threw open the nuances that informed key learnings.

These discussions along with reflections from the project team are put together and will form a basis for arriving at the frameworks and toolkits for climate action for cultural heritage. The last section has a glossary of terms used in the compendium where the terms are defined and explained with the intention of developing a common understanding of the subject.

Climate Change and Cultural Heritage, Challenges for Indian Cities

India is a country of unparalleled diversity which makes it unique and vibrant. There are various bio-geographic zones which have distinctive physical characteristics and climatic conditions. Bio-geographic zones have been broadly characterized as Trans Himalayas, Greater Himalayas, Lesser / Middle Himalayas, Siwalik Hills / Outer Himalayas, Northeast Hills, Indo-Gangetic Plains, Desert / Arid Zone, Semi-Arid Zone, Central Highlands, Deccan Plateau and Southern Peninsular Plains, Western Ghats, Eastern Ghats, Coasts and Islands. These bio-geographic zones have different environmental and geographic conditions which have resulted in ecological diversity. Boundaries of Indian administrative and political states and Union Territories are largely determined by the bio-geographic zones which have been the genesis of distinctive cultural uniqueness. These zones are vulnerable to character specific Hydro-Met disasters such as, cyclones, floods, droughts, heat-waves and cold spells and coastal storm surges.

These hazards impact cultural and built heritage with varied intensities which could range from gradual and hence discernible as cumulative impact (impact over time) to immediate catastrophic impact. .. Vulnerability of heritage to climate related hazards is dependent on several factors. Assessment of climate related risks on built and cultural heritage is essential to plan for mitigation and adaptation. In order to protect heritage across the country using an equitable framework would require regions across the nation to collect and collate information so as to evaluate heritage under various parameters. First and foremost, information on the location of settlement, urban, semi urban or rural would need to be listed within its the bio-geographic zone. The type of hazards and vulnerability level would need to be accurately listed from reliable secondary sources against each of the settlements. Next, second type of information which requires to be listed is the historical and socio-cultural significance of the place. This needs to include overall understanding of the regional and local cultural narrative of the people of the place. The third level of information is information on the tangible and intangible heritage. This would include buildings and structures, precincts, cities. These can be classified further under protected and unprotected buildings (by law under both national, regional and local legal tools). World Heritage sites designated under the UNESCO World Heritage Convention can be listed as a separate category. Intangible heritage can be listed based on the classification provided by UNESCO for the Creative Cities Network. This is the first set of criteria to understand the nature of heritage and the vulnerabilities. The above listed information gives insights into various aspects related to the cultural and built heritage and impact of climate change and hence some leading questions emerge with this preliminary information.

The next most important layer of information is on materiality of built heritage in the area. This information is essential to determine the intensity of impact on the heritage. It becomes important to consider the attributes of the materials which have been used in buildings of heritage significance, for instance buildings in earth or wood are more susceptible to increase in precipitation as compared to bricks and stone.

By creating a matrix with these parameters, it is the first step towards taking cognisance of various aspects to be considered for planning for mitigation or adaptation towards protection of heritage through various types of action. This matrix aids in prioritizing interventions and resource allocation by offering a comparative overview. This approach facilitates the development of targeted strategies for disaster risk reduction and heritage preservation. Regular updates are essential to ensure the matrix remains reflective of changing conditions, allowing for dynamic and adaptive urban planning and cultural heritage management.

There have been several schemes / programs of Government of India which are model programs for sustainable development in cities, such as, HRIDAY scheme (for 12 cities), CITIIS program (12 cities), Smart Cities (100 cities). Several cities were selected to be provided with financial and technical resources for implementation of these schemes and programs. Those cities which demonstrate planned interventions in and / or around cultural heritage, both tangible and intangible, were selected and examined under the various parameters in the matrix as defined above. These include all 12 cities from the HRIDAY scheme, all 12 cities from the CITIIS program, SMART cities which identified historic areas for 'Area Based Development' as (ABD as defined in the program). Also, it included three world heritage cities, world heritage sites which are inscribed or are in the tentative list for world heritage nomination. Cities included in the UNESCO Global Network of Creative Cities

due to the significant intangible heritage too have been included.

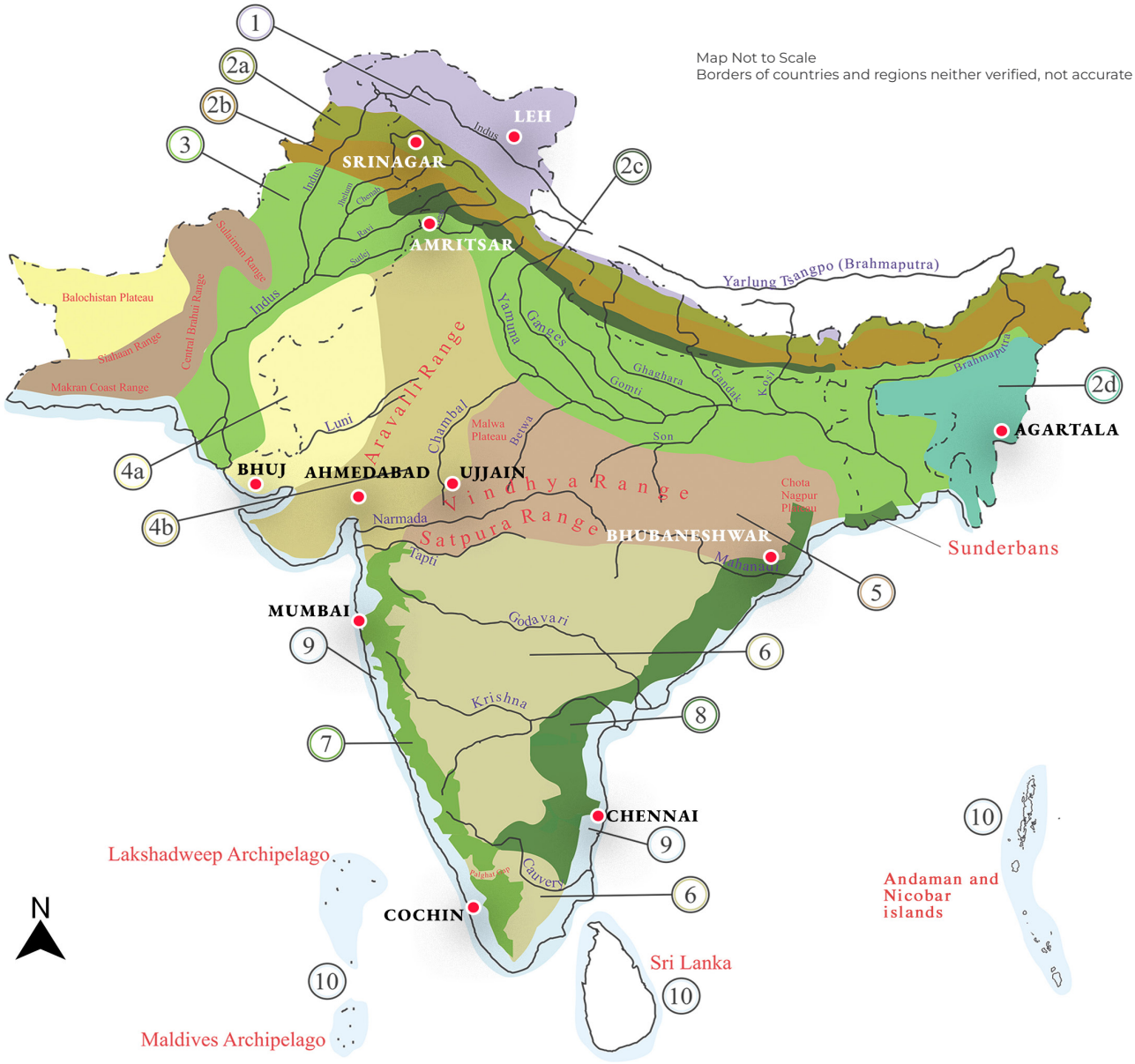
As described above information on pre dominant typology of built heritage and materiality , intangible heritage including creative industries, fairs and festivals were listed for the identified cities and towns . Information related to climate change comprising hazards and vulnerability levels was listed. Though assessment of severity appears to be a linear process, where vulnerability risk is a direct indicator of it, multidimensional aspects may alter impact. Interpreting the matrix requires correlating between different parameters. For instance, Leh has low vulnerability level with increase in precipitation as a hazard but materiality of built heritage being earthen material makes a severe impact. Chanderi has moderate risk with drought as a hazard, craft of weaving is recognised as a significant cultural resource and is included in the tentative list of World Heritage Site, prioritisation of planning in such a city becomes necessary.

Assessment of tangible heritage enables prioritisation of conservation efforts. A city with a high concentration of buildings and monuments of heritage significance, more specifically inhabited by communities, such as inner cities would require urgent planning measures to protect both lives and cultural heritage assets. Similarly, evaluating the risk to intangible heritage helps identify human settlements where cultural practices are under threat, necessitating strategies to ensure livelihoods through continuity in practice

By providing a comprehensive understanding of each city's unique strengths and challenges, planning authorities in dialogue and collaboration with stakeholders would be required to develop tailored strategies to protect and conserve cultural and built heritage against vulnerabilities induced by climate change through mitigation and adaptation.

Note- The table overleaf contains preliminary information and requires further research.

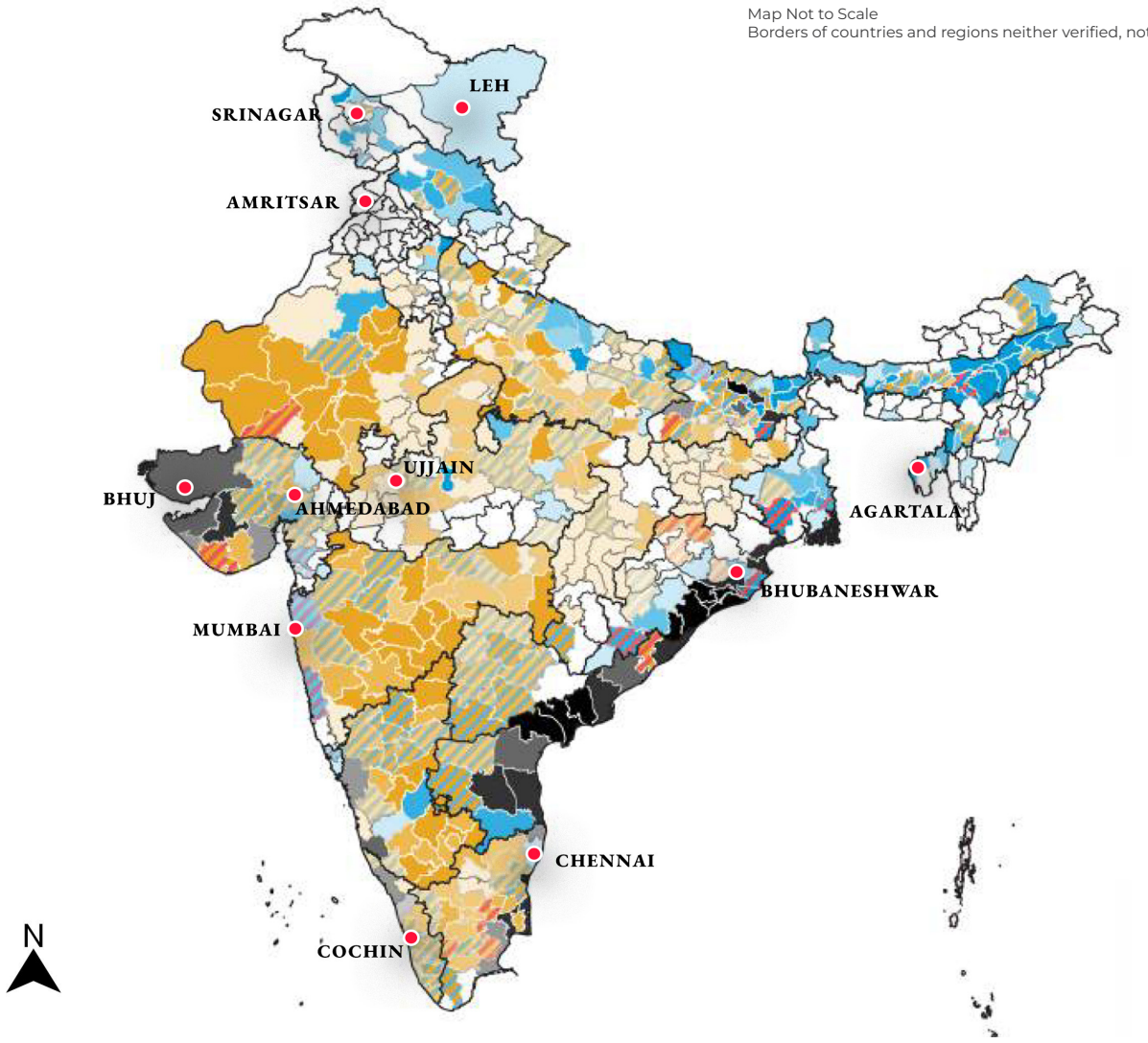
Indian Subcontinent- Biogeographic Zones

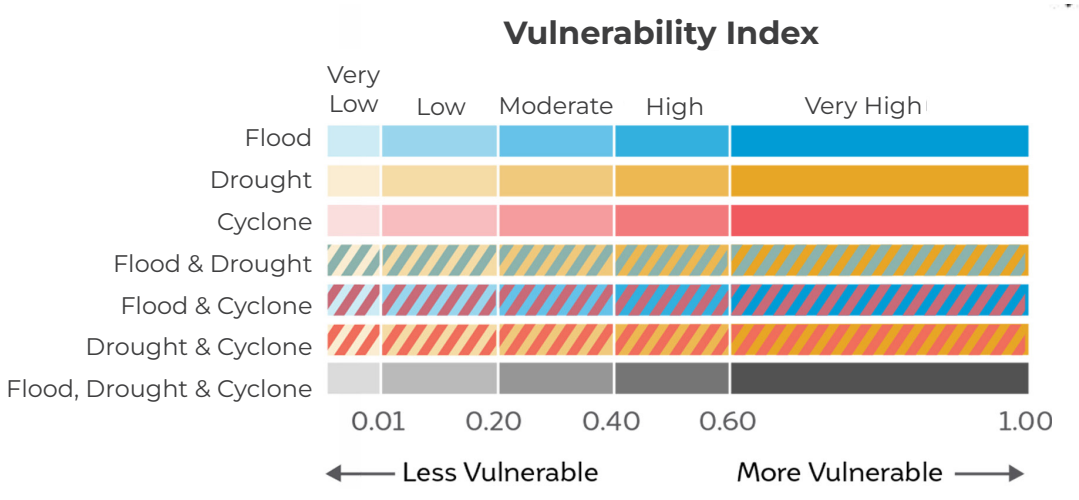


1 Trans- Himalayas
2a Greater Himalayas
2b Lesser/ Middle Himalayas
2c Siwalik Hills/ Outer Himalayas
2d Northeast Hills
3 Indo- Gangetic Plains
4a Desert/ Arid Zone
4b Semi- Arid Zone
5 Central Highlands
6 Deccan Plateau & Southern Peninsular Plains
7 Western Ghats
8 Eastern Ghats
9 Coasts
10 Islands

Source - Khan, A. (2020), *Biogeographical map of Indian Subcontinent.* Retrieved from https://commons.wikimedia.org/wiki/File:Biogeographical_map_of_Indian_Subcontinent001.jpg

Map of India Showing Climate Vulnerability Index Zones





Source - Mohanty, A., Wadhawan, S. (2021), *Mapping India's Climate Vulnerability, A District Level Assessment*, p. 36. Retrieved from, https://www.ceew.in/sites/default/files/ceew-study-on-climate-change-vulnerability-index-and-district-level-risk-assessment.pdf

Sr. No.	Historic Cities						Bio geographic Zone	Primary Hazards	Vulnerability Level	Tangible Heritage	Materials of Built Heritage	Intangible Heritage
	Name of the City	Gov. Supported Programs			WH City	OT						
		SC	CI	HR								
North Zone												
1	Ajmer	✓		✓			4a		High	NH	S, B, L	
2	Amritsar	✓	✓	✓			3		Moderate	WH (T)	B, W	
3	Chandigarh	✓					3		Low	WH (I)	C, B	
4	Delhi	✓					3		High	WH (I)	S, B	
5	Jaipur	✓			✓		4a		High	WH City	S, L	
6	Kota	✓					4b		Low	NH	S	
7	Leh					✓	1		Low	NH	E, W	
8	Pushkar			✓			4a		Very High	NH	S, B	
9	Shimla					✓	2c		Moderate	WH (I)	W, S	
10	Srinagar	✓					2a		Moderate	WH (T)	W, S	
South Zone												
11	Amravati	✓	✓	✓			8		High	NH	S	
12	Badami			✓			6		Moderate	WH (T)	S	
13	Belagavi	✓					6		Low	RH	S	
14	Chennai	✓	✓				9		High	NH	W, B, C, S	
15	Davangere	✓					6		High	NH	S	
16	Hubballi-Dharwad	✓	✓				7		Low	NH	S	
17	Kakinad	✓					9		Very High	RH	S	
18	Kanchi-puram			✓			8		Moderate	WH (T)	S	
19	Kochi	✓	✓				9		High	NH	S, B, W	
20	Koyyala-gudem					✓	7		Very High	WH (T)	S	
21	Madurai	✓					6		Low	NH	S, W	
22	Nilambur*					✓	7		Very Low	RH	S, W	
23	Pocha-mpalli					✓	8		Very Low	WH (T)	S, B, W	
24	Puducherry	✓	✓				9		Very Low	NH	B, W, L	
25	Shiva-mogga	✓					7		Low	NH	S	
26	Thrissur*					✓	9		Moderate	NH	S, W, L	
27	Vellankanni			✓			9		Low	NH	S	
28	Vishakha-patanam	✓	✓				9		High	RH	S	
29	Warangal*	✓		✓			8		Moderate	NH	S	
Central Zone												
30	Bhopal	✓					5		Very Low	NH	B, L, S	
31	Chanderi					✓	5		Moderate	WH (T)	S	
32	Dehradun	✓	✓				2c		Low	NH	B, S	
33	Kanpur	✓					3		Moderate	NH	B	
34	Lucknow	✓					3		Moderate	NH	S, B	
35	Mathura			✓			3		Very Low	WH (T)	B	

Sr. No.	Historic Cities						Bio geographic Zone	Primary Hazards/ Extreme Weather Events	Vulnerability Level	Tangible Heritage	Materials of Built Heritage	Intangible Heritage
	Name of the City	Gov. Supported Programs			WH City	OT						
		SC	CI	HR								
36	Mubarak-pur					✓	3	● ●	Very Low	WH (T)	S	■
37	Orchha					✓	5	●	Moderate	WH (T)	S	■
38	Sagar	✓					5	●	Very Low	NH	S	■
39	Ujjain	✓	✓				4b	●	Moderate	NH	B, S	▲ ■
40	Varanasi	✓		✓			3	●	Very Low	WH (T)	B, S	▲ ■
West Zone												
41	Ahmedabad	✓			✓		4b	● ●	High	WH City	W, B, S	▬
42	Bhuj					✓	4a	● ● ●	High	WH (I)	S, W, E	■
43	Dwaraka			✓			9	● ● ●	Very High	NH	S	▲ ■
44	Kalyan-Dombivali	✓					7	● ●	Moderate	RH	B, W, S	■
45	Mumbai	✓			✓		9	● ●	Moderate	NH	B, S, C	▬
46	Nashik	✓					6	● ●	Low	NH	S	▲ ■
47	Paithan				✓		6	●	Very High	WH (T)	S, W	■
48	Panaji	✓					9	●	Moderate	RH	BA, L, E	■
49	Pune	✓					6	● ●	Moderate	NH	B, S, W	■
50	Surat	✓	✓				4b	● ●	Low	NH	S, W	■
51	Thane	✓					9	● ●	Moderate	NH	S, W	▬
52	Vadnagar					✓	4b	● ●	Moderate	WH (T)	B, S	■
53	Yeola					✓	6	● ●	Moderate	WH (T)	S	■
East Zone												
54	Bhuba-neswar	✓	✓				5	● ● ●	High	WH (I)	S	■
55	Darjeeling					✓	2b	●	Very High	WH (I)	S	■
56	Gaya			✓			3	●	Moderate	WH (I)	B, S	▲ ■
57	Puri, Kornak			✓			9	● ● ●	Very High	WH (I)	S	▲ ■
58	Ranchi	✓					5	●	Very Low	NH	BA, B, W	■
North-East Zone												
59	Agartala	✓	✓				2d	●	High	RH	B, E	■
60	Guwahati	✓					2d	●	High	NH	W	■
61	Namchi	✓					2b	●	High	RH	S, W	■
62	Sualkuchi					✓	2d	●	High	RH	BA, B, W	■

* UNESCO Global Network of Learning Cities

Government Supported Programs: **SC-** Smart Cities Mission, **CI-** CITIIS Program, **HR-** HRIDAY Scheme, **WH City-** World Heritage City, **OT-** Other Small and Medium Towns

Primary Hazards/ Extreme Weather Events: ● Flood ● Drought ● Cyclone

Tangible Heritage: **WH (I)-** Inscribed in World Heritage List, **WH (T)-** On World Heritage Tentative List, **NH-** National Heritage, **RH-** Regional Heritage

Materials of Built Heritage: **S-** Stone, **B-** Brick, **E-** Earth, **L-** Lime, **BA-** Bamboo, **W-** Wood, **C-** Concrete

Intangible Heritage: ▲ Sacred Site ■ Creative Industry / Craft Practice ▬ Other Intangible Heritage

Biogeographic Zones:

- 1 Trans- Himalayas
- 2a Greater Himalayas
- 2b Lesser/ Middle Himalayas
- 2c Siwalik Hills/ Outer Himalayas
- 2d Northeast Hills
- 3 Indo- Gangetic Plains
- 4a Desert/ Arid Zone
- 4b Semi- Arid Zone
- 5 Central Highlands
- 6 Deccan Plateau & Southern Peninsular Plains
- 7 Western Ghats
- 8 Eastern Ghats
- 9 Coasts

Climate Action Plans

India experiences a diverse and varied climate due to its varied geographical extent and topographical variations. Understanding its characteristics and aspects is vital for various sectors such as agriculture, water management, disaster preparedness and various others. Due to a combination of nature and human induced factors, climate change in the country is evident as similar to the rest of the world. Greenhouse gas emission in the atmosphere due to long term and intensive industrial growth, lifestyle changes, deforestation, energy production and consumption are a main cause behind the climate change.

With an economy that is tightly connected to its natural resource base and sectors that are climate-sensitive such as agriculture, water, and forestry, India may face a serious challenge as a result of expected climate changes. In India more than 65% of the population depends on climate sensitive agriculture and forestry sectors, while 60% of the area is susceptible to drought. (GIZ, 2011) Hence, climate change in India is a pressing and multifaceted issue which is impacting various sectors such as, agriculture, biodiversity, environment, ecology, economics and eventually overall growth of the country. Several factors contribute to the urgency of addressing the issue of climate change which includes vulnerability due to climate change for example rise in temperature, change in rainfall patterns, extreme weather events, water stress, rising sea levels, biodiversity loss and many more.

There are 17 goals under UN Sustainable Development Goals, having sustainable habitats as one of them. As per 2023 report, India 112 against 166 countries whose sustainable indices have been calculated. (SDG Index and Dashboards Report- India Profile, 2023) Unfortunately, in the sustainable habitat goal the index indicates the major challenges remains in this area, as this is the only goal in the year 2022 in which is reported downward direction.

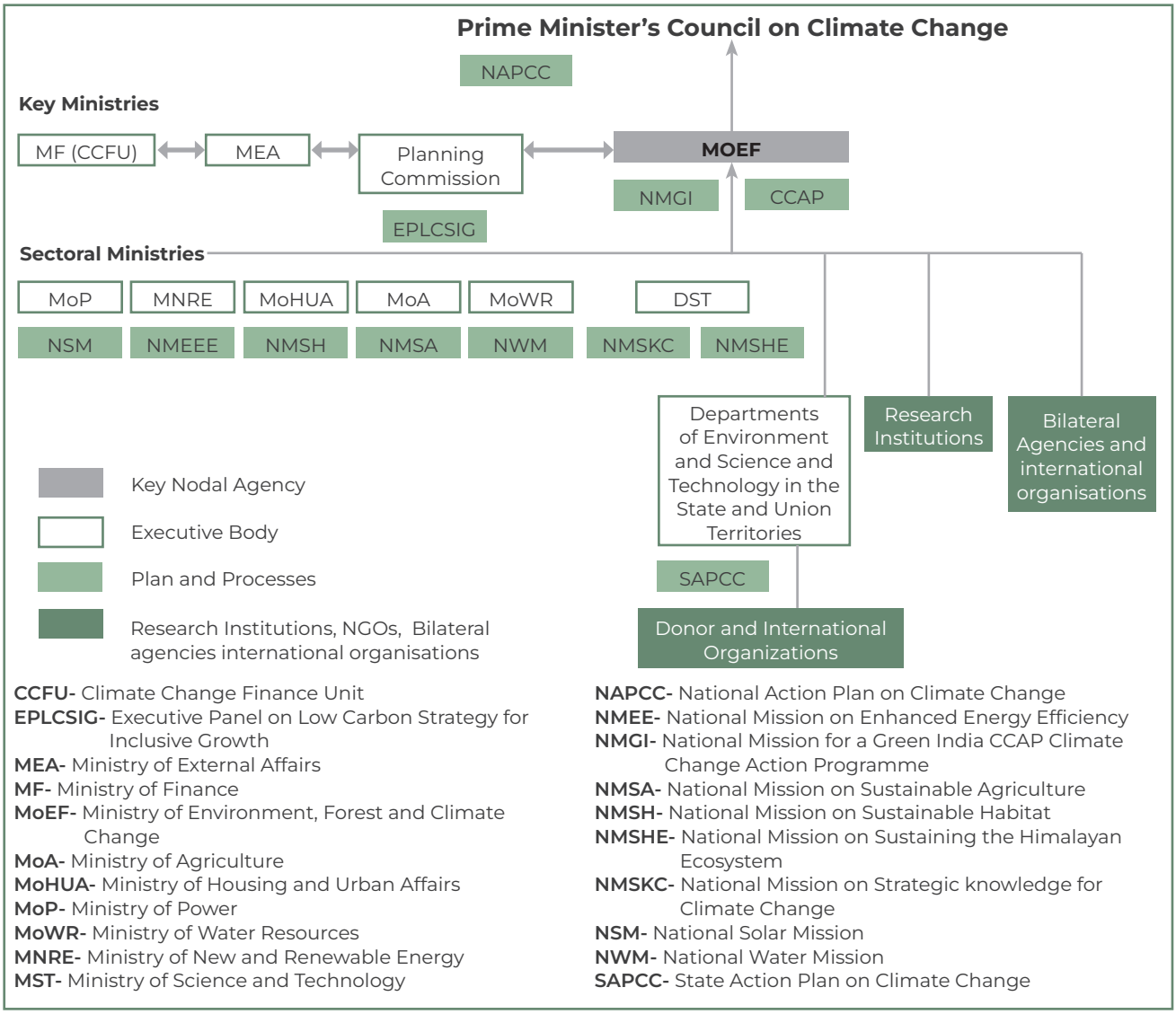
Recognising these challenges, MoEF, Government of India has been actively engaged in international efforts to mitigate climate change, reduce emissions, and adapt the changing climate through sustainable development and policies. One such effort is the 'Action Plan on Climate Change' which was based on the principle of common but differentiated responsibilities and respective capabilities, included in the United Nations Framework Convention on Climate Change (UNFCCC). Climate change action plans are essential for India to pro-actively address the challenges posed by a changing climate. These plans encompass strategies for adaptation, mitigation, and sustainable development, ensuring that the country can navigate the impacts of climate change while fostering long-term environmental and socio-economic resilience. Action plan on Climate Change was prepared at various levels which includes National, State and City level plans.

The National Action Plan on Climate Change (NAPCC) was launched in June, 2008 by the Prime Minister's Council on Climate Change. It aims at creating awareness among the representatives of the public, different agencies of the government, scientists, industry and the communities on the threat posed by climate change and the steps to counter it.

There are **8 National Missions** forming the core of the NAPCC which represent multi-pronged, long term and integrated strategies for achieving key goals in climate change. (Government of India, Prime Minister's Council on Climate Change, n.d.) Various ministries hold the primary implementation responsibility of these missions such as, **National Solar Mission** under the Ministry of New & Renewable Energy, **National Mission for Enhanced Energy Efficiency** under the Ministry of Power: Bureau of Energy Efficiency, **National Mission on Sustainable Habitat** under the Ministry of Housing and Urban Affairs holds the primary implementation responsibility for the mission, **National Water Mission** under the Ministry of Jal Shakti, Department of Water Resources, River Dev & Ganga Rejuvenation, **National Mission for Sustaining the Himalayan Ecosystem** under the Ministry of Science & Technology, **National Mission for A Green India** under the Ministry of Environment, Forests & Climate Change, **National Mission for Sustainable Agriculture** under the Department of Agriculture & Cooperation, State Governments, National Centre of Organic Farming, Central Fertilizer Quality Control Institute etc., **National Mission on Strategic Knowledge for Climate Change** under the Ministry of Science & Technology. (Ministry of Environment, Forest and Climate Change, 2021)

National Mission on Sustainable Habitat is being implemented through various flagship missions/ programmes sucha as, Atal Mission on Rejuvenation and Urban Transformation (AMRUT), Swachh Bharat Mission, Smart Cities Mission, Urban Transport Programme etc.

The institutional basis for the training manual is provided in the City Climate Action Plan.



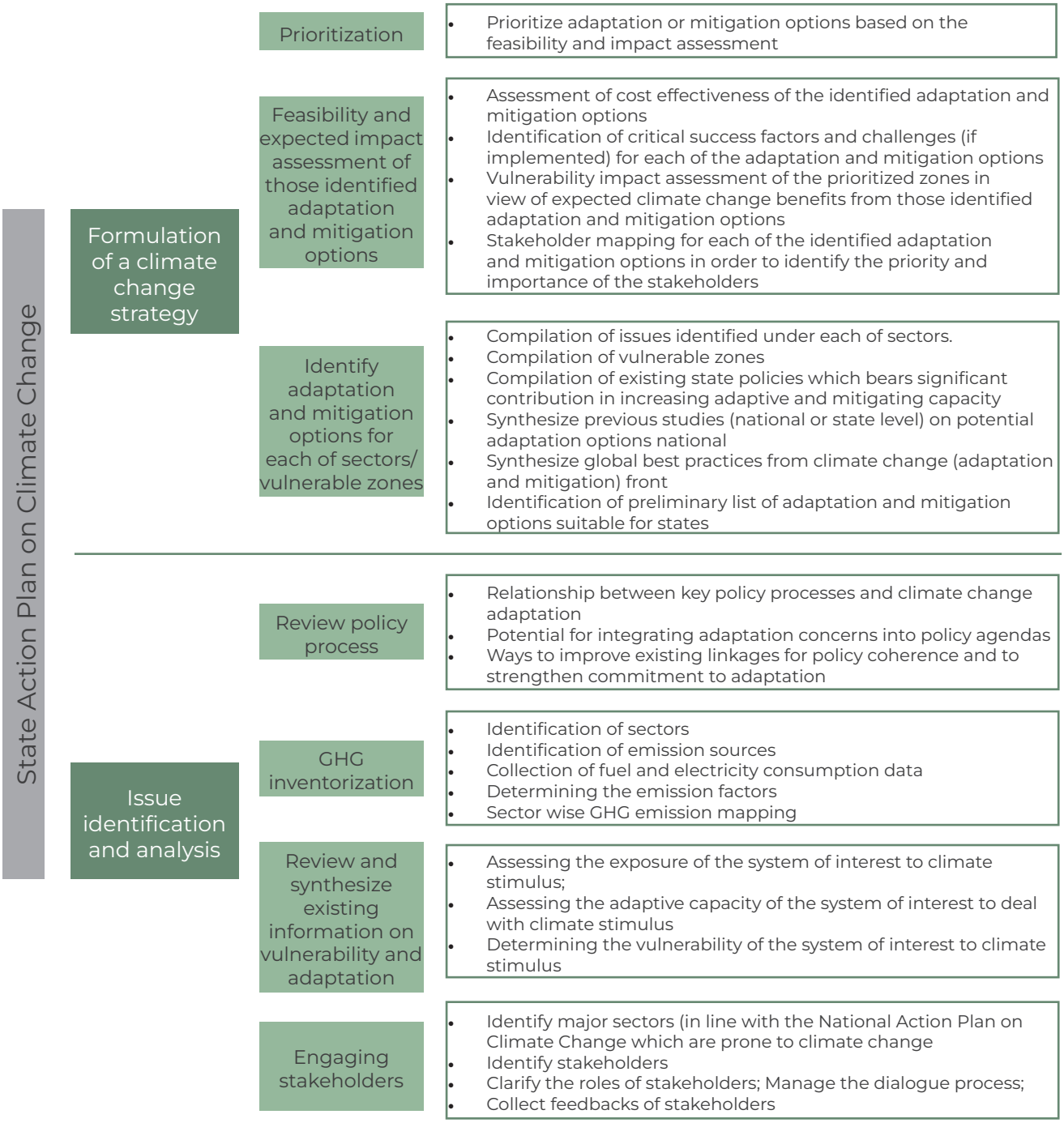
Institutional arrangements for climate change policy in India

(Source - National Institute of Urban Affairs. (2021). *City Climate Action Plan - Training Manual*, p. 12. Retrieved October 4, 2023, from https://niua.in/c-cube/sites/all/themes/zap/pdf/climate-action-plan.pdf)

In accordance with the strategy outlined in the National Action Plan on Climate Change (NAPCC), the Indian government instructed all state and union territory administrations to develop State Action Plans on Climate Change (SAPCC) in 2009. The SAPCCs are the result of a top-down procedure. The majority of the states developed their plans between 2010 and 2011, using consultants provided by development organizations. The plans have a consistent format and outline the state's particular climate change vulnerabilities as well as how the state will adapt to both immediate and long-term effects. The strategies for the state's various sectors are outlined in the plans, along with suggested projects and in certain cases, a timeline and financial plan for each. The focus areas are agriculture, water, transport, energy, industries, urban planning, and forestry that are crucial to the local economy and way of life.

State governments engage with various stakeholders, city level authorities, local communities, non-governmental organizations, institutes and other agencies to ensure that it aligns with the needs of diverse communities. In the action plan, the states included initiatives for capacity building which strengthens the ability to implement and manage the climate change initiatives effectively. These plans also consist of monitoring and evaluation for the regular assessment in refining the initiatives based on changing climate patterns. Mostly, the activities span between one to five years. States have varied budget projections, and there is no standard system in practice.

State Action Plans include mitigation measures such as, green buildings, provision for ventilation, use environment friendly building materials, renewable energy, energy efficient devices, water use efficiency & efficient drainage, shifting industry out of residential areas, solid & liquid waste management, legacy waste remediation, improved transport infrastructure- MRTS (Mass Rapid Transit System) environment friendly vehicles, restoration of water bodies and adaptation measures such as, main-streaming conservation: green setbacks / urban forestry, filter polluted air & reduce smog, prevent local soil erosion, paved & unpaved areas for rain/ storm water harvesting, reducing traffic through staggered timings, separate storm water drains to hold extra water & avoid flooding, promotion of energy efficient gadgets, adopting nature based solutions.



Approach and methodology for development of SAPCC

(Source - National Innovations in Climate Resilient Agriculture (NICRA). (2011). *Andhra Pradesh State Action Plan on Climate Change*, p. 123. Retrieved October 4, 2023, from http://www.nicra-icar.in/nicrarevised/images/State%20Action%20Plan/AP-SAPCC.pdf)

City Action Plans are strategic documents developed by a city or urban local bodies to address the challenges of climate change and promote sustainability. Specific strategies and targets to reduce emissions and adapt to the changing climate, making cities more livable, sustainable, and resilient in the face of climate challenges. The process to form City Action Plan requires establishing the overall vision to derive mitigation and adaptation

strategies and eventually develop a comprehensive plan. The detailed process is given below:

Typical City Climate Action Plan planning process

(Source - United Nations Human Settlements Programme (UN-Habitat). (2015). *Guiding Principles for City Climate Action Planning*, p. 10. Retrieved October 4, 2023, from https://unhabitat.org/sites/default/files/downloadmanager-files/English%20Publication.pdf)

These plans are essential for mitigating the impacts of climate change and ensuring the well-being of city residents. A City Action Plan on Climate Change is created and put into action through an iterative process that calls for continual commitment and cooperation. Successful CAPs are the result of the combined efforts of local governments, communities, and other stakeholders in managing climate change concerns and creating resilient and sustainable cities. Some of the action plans prepared are Heat Action Plan for Ahmedabad, Surat and Bhubaneswar, Action Plan for Clean Air for Amritsar, Chennai, Dehradun, Dhanbad, Gaya, Hubli-Dharwad, Surat and Visakhapatnam, Solid Waste Management Plan for Mathura and Varanasi, City Sanitation Plan for Puri and various others.

City Action Plans are made to address vulnerabilities related to specific climate change aspects and to take action, different strategies have been identified which could be mitigation strategies or adaptation strategies. Mitigation strategies are implemented to reduce emissions that cause climate change, while adaptation strategies basically focus on adjusting to the expected and the actual effects of climate change.

The potential of state governments and urban local bodies to implement the strategies for action in a comprehensive, coordinated manner is critical in ensuring that intentions are translated into actions that have a significant impact on emissions reduction and resilience-building. Identifying the challenges to implementation is an initial step toward overcoming them. Through these action plans and other programs/ policies, India is becoming a responsible and informed member of the global society, prepared to contribute to the resolution of a global issue that impacts all of humanity.

Learnings from the Smart Cities Mission

India's urbanization offers a potential prospect for economic expansion and development. Cities develop into centers for innovation, education, and entrepreneurship as people relocate from rural to urban areas in quest of better opportunities. This rapid population shift from rural to urban causes pressure on the infrastructure, housing and basic services in place. As per Census 2011, nearly 31% of India's current population lives in urban areas and contributes 63% of India's GDP (Ministry of Home Affairs, n.d). Earlier estimations indicate that about 416 million people will be added as urban dwellers in India between 2018 and 2050 and that India will be 50% urban by 2050. (NITI Aayog, 2021)

This poses a huge challenge for cities while also providing an opportunity. It necessitates the diverse growth of the institutional, physical, social, and economic infrastructure. Towards this end, steps have been taken to improve urban infrastructure through various schemes such as, JNNURM (Jawaharlal Nehru National Urban Renewal Mission) and AMRUT (Atal Mission for Rejuvenation and Urban Transformation). The development of Smart Cities is a movement in that direction. Smart City Mission differs from both the schemes as it focuses on technology-driven urban development, a competitive city selection process, and a broader range of projects with area-based development, aimed at transforming cities into smart and sustainable entities. JNNURM, aimed to enhance infrastructure, urban governance and efficient transportation systems, while AMRUT primarily concentrated on basic urban infrastructure and services for all urban areas.

The aim of the Smart City Mission is to drive economic growth and improve quality of life through comprehensive work on the social, economic, physical, and institutional pillars of the city. (Ministry of Housing and Urban Affairs, 2021a) The goal is to create replicated models that serve as guides for other aspirant cities, with an emphasis on development that is both sustainable and inclusive. Smart City Mission was launched on 25 June 2015 and sponsored by Central Government of India.

The six guiding principles that the concept of smart cities is built on in the context of India are:

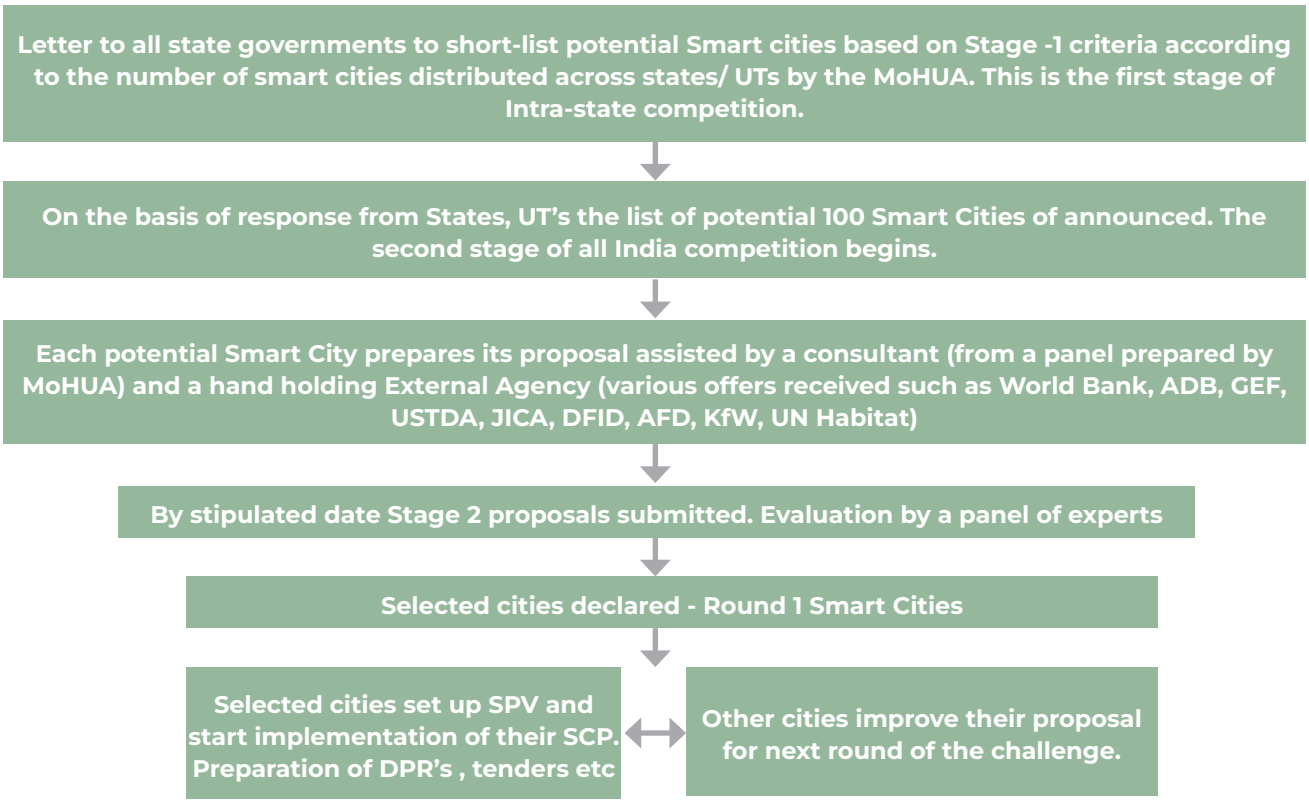
Fundamental principles as the base of Smart City concept
(Source - Ministry of Housing and Urban Affairs. (2021). *Smart Cities Mission, About the Mission*. Retrieved September 12, 2023, from https://smartcities.gov.in/about-the-mission)

The core infrastructure elements in a Smart City include- adequate water supply, assured electricity supply, sanitation, including solid waste management, efficient urban mobility and public transport, affordable housing, especially for the poor, robust IT connectivity and digitalization, good governance, especially e-Governance and citizen participation, sustainable environment, safety and security of citizens, particularly women, children and the elderly, and health and education. (Ministry of Housing and Urban Affairs, 2021a)

100 cities were selected under the Smart Cities Program to be developed as Smart Cities through a two-stage competition and its duration was initially envisaged to be for five years (FY2015-16 to FY2019- 20) which has been revised to 2024.

The concept of competitive and cooperative federalism served as the foundation for the selection process for Smart Cities. For the first time in India's urban history, cities were chosen through a competitive process.

The selecting procedure was divided into two stages. In the first stage, States/ UT short-listed potential smart cities on the basis of certain pre-conditions and scores. In the second stage of the competition, each of the potential 100 Smart Cities prepared their Smart City Proposal (SCP) which contained the model chosen (retrofitting or redevelopment or greenfield development or a mix thereof) and additionally included a Pan-city dimension with smart solutions.



Selection Process

(Source - Ministry of Housing and Urban Affairs. (2015, June). *Mission Statement and Guidelines*, p. 10. Retrieved September 12, 2023, from https://smartcities.gov.in/guidelines)

The Smart Cities Mission sought to improve people's quality of life and direct economic growth by promoting local area development and utilizing technology, particularly technology that produces smart outcomes. Thus, the strategy included Area-Based Development (ABD) plus pan-city initiatives for comprehensive development. Area-based development aimed to transform existing areas (retrofit and redevelop), including slums, into better-planned areas, thereby improving the liveability of the whole city. Development of new areas (green-fields) around cities are aimed to accommodate the expanding population in urban areas. (Ministry of Housing and Urban Affairs, 2021a) Cities could utilize technology, knowledge, and data to enhance their infrastructure and services by applying smart solutions. Such comprehensive development was targeted towards making inclusive cities by raising revenue for everybody, especially the underprivileged and disadvantaged, while also enhancing the quality of life.

The strategic components of Area-based development in the Smart Cities Mission are city improvement (retrofitting), city renewal (redevelopment), and city extension (greenfield development) plus a Pan-city initiative in which Smart solutions are applied covering larger parts of the city. (Ministry of Housing and Urban Affairs, 2021a)

The selected Smart Cities were not required by the government to use a pre-determined model. Each city had the possibility to develop its own idea, vision, goal, and strategy (proposal) for a Smart City that is relevant to its local context, resources, and levels of ambition. The approach was not 'One-size-fits-all'. Cities created their Smart City Proposal (SCP), which outlined their vision, strategy for allocating resources, and desired objectives for smart applications and infrastructure improvement.

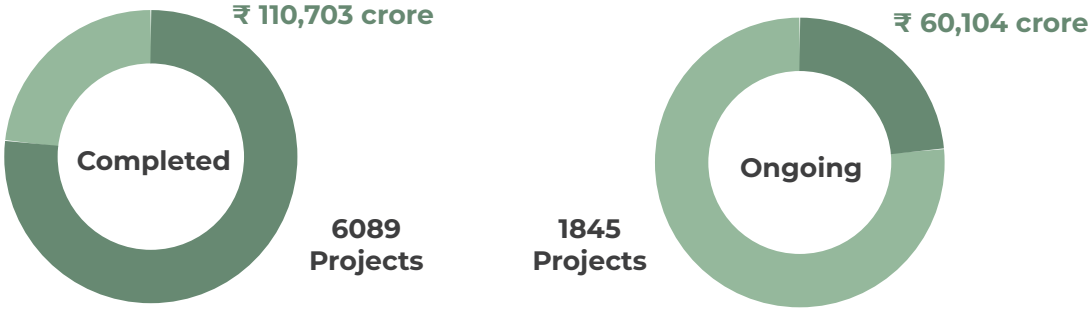
The elements that had to form part of an SCP are assured electricity supply with at least 10% of the Smart City's energy requirement coming from solar, adequate water supply including waste water recycling and stormwater reuse, sanitation including solid waste management, rain water harvesting, smart metering, robust IT connectivity and digitalization, pedestrian friendly pathways, encouragement to non-motorized transport (e.g. walking and cycling), intelligent traffic management, non-vehicle streets/zones, smart parking, energy efficient street lighting, innovative use of open spaces, visible improvement in the area (e.g. replacing overhead electric wiring with underground wiring, encroachment-free public areas, and ensuring safety of citizens, especially children, women and elderly). In addition to the crucial components listed above, at least 80% of the structures in redevelopment and greenfield models of smart cities needed to be energy-efficient and environmentally friendly. Furthermore, at least 15% of the total housing units in a greenfield construction had to fall into the affordable housing category.

The Mission was carried out at the city level by a Special Purpose Vehicle (SPV) established for that purpose. The SPV develops the Smart City development projects and plans, examines, authorizes, releases money, implements, manages, operates, monitors, and evaluates them. For the purpose of creating, developing, managing, and putting into action area-based projects, the SPV may hire Project Management Consultants (PMC). Any empanelled consulting company on the list compiled by MoHUA and the handholding agencies could provide assitant to SPVs. (Ministry of Housing and Urban Affairs, 2021d)

The objective to create smart cities faced certain challenges. States and ULBs are important partners in the creation of Smart Cities. The success of the Mission was influenced by smart leadership, clear vision, and the capacity for decisive action. Additionally, capacity assistance was necessary for policymakers, implementers, and other stakeholders at various levels to understand the ideas of retrofitting, redevelopment, and greenfield development.

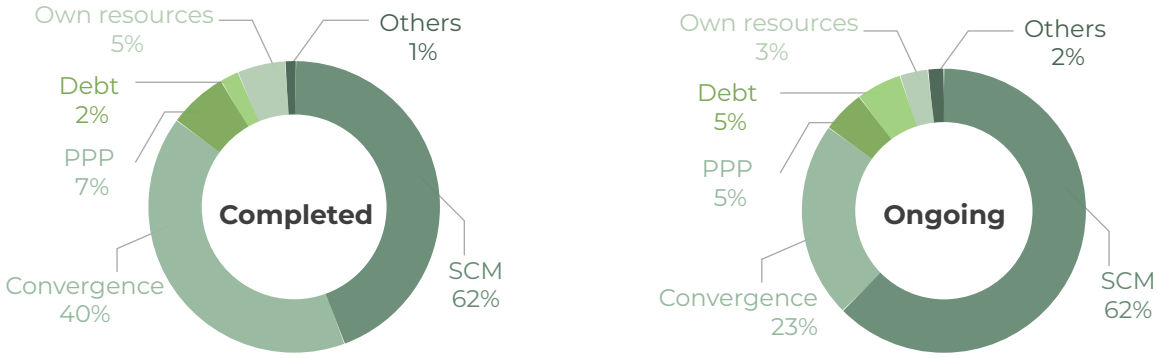
The Central Government gave financial support to the Mission to the extent of INR 48,000 crores over five years i.e. on an average of Rs. 100 crore per city per year. An equal amount, on a matching basis, was contributed by the State/ ULB; therefore, nearly rupees one lakh crore of Government/ ULB funds were available for Smart Cities development. (Ministry of Housing and Urban Affairs, 2021b)

There were 7934 total projects in 100 smart cities worth 1,70,807 crore from which 6089 projects worth 1,10,703 crore have been completed while 1845 projects worth 60,104 crore are ongoing projects. (Ministry of Housing and Urban Affairs, 2021b)



Progress of the Projects

(Source - Smart Cities Mission. (n.d.). Mission Dashboard. Retrieved September 22, 2023, from https://smartcities.gov.in/mission-dashboard)



Funding pattern of Projects

(Source - Smart Cities Mission. (n.d.). *Mission Dashboard*. Retrieved September 22, 2023, from https://smartcities.gov.in/mission-dashboard)

It is interesting to note that 38 out of the 100 cities, identified their historic cities to be developed for the ABDs. Some of the examples being Amritsar, Jaipur, Srinagar, Varanasi, Warangal, Kochi etc.

In Jaipur Smart City, the implementation of intelligent traffic management systems aims to enhance urban mobility and also contributes to climate change mitigation by reducing traffic congestion and emissions. Smart environment sensors will collect information on pollution, environment conditions (Temperature and humidity), and other occurrences on an hourly and daily basis. In order to help the city take corrective action, the sensors will provide information that will allow administrators and residents to monitor their activities that have an influence on the environment on the World heritage city Jaipur. (Ministry of Housing and Urban Affairs, 2015c)

Kochi is highly vulnerable to flood and drought and therefore, Kochi Smart City project deployed water management systems with sensors which can optimize water distribution, reduce leakages and enhance overall water use efficiency. The project initiated the environmental system provisions, such as rainwater harvesting, solar roof panel installation, effective sewage and sanitation systems in the city. It will reduce or eliminate wastewater discharge into canals, effectively recharge groundwater and decrease dependability on conventional energy sources. (Ministry of Housing and Urban Affairs, 2015d)

In Bhubaneswar Smart City, the emphasis on creating green spaces and improving urban forestry as part of the Smart Parks initiative aligns with climate change adaptation strategies. Increased green cover helps in temperature regulation, mitigates the urban heat island effect, and enhances the city's resilience to extreme weather events. It also includes several area based development such as, water management through rain water harvesting and landscaping, recycle centers for waste management and generating energy thorough solar. (Ministry of Housing and Urban Affairs, 2015b)

Learnings from Interventions in historic areas and the institutional mechanisms developed to address the needs and aspirations of local community, types of interventions undertaken in historic areas for risk preparedness due to climate change and further, infrastructure developed for disaster management and risk preparedness in the Smart Cities is invaluable resource to develop climate action plans for cultural and built heritage in Indian cities.

Learnings from CITIIS Program

To address the complex urban challenges faced by Indian cities, to promote innovation and sustainability in urban development and to enhance live-ability the CITIIS Program was launched in the year 2018.

The CITIIS (City Investments to Innovate, Integrate and Sustain) program is conceptualised to assist Indian cities in implementing urban infrastructure projects that are integrated, innovation driven and sustainable. (National Institute of Urban Affairs, n.d.-b) The program was initiated by the Ministry of Housing and Urban Affairs (MoHUA), Government of India as a sub component of the Smart Cities Mission for a more inclusive and sustainable urban development in India. It is supported by Agence Française de Développement (AFD) and the European Union (EU). The project is being managed and coordinated by the Program Management Unit (PMU) at the National Institute of Urban Affairs (NIUA), New Delhi. (National Institute of Urban Affairs, 2019)

For the selection procedure, 36 cities submitted a total of 67 project proposals. CITIIS PMU and a nine-member jury assessed these projects using an online assessment tool and program guidelines. 27 projects from 20 cities were selected in this first round. Further, these shortlisted projects were assessed by the Jury through four key values of the CITIIS program - Excellence in Sustainable Urban Development, Innovation and Integration, Participatory approaches and Relevance and feasibility. (National Institute of Urban Affairs, 2019)

Excellence in Sustainable Development Social Inclusion and gender Climate and environmental issues Sustainability **25%**	**Participatory Approach and Partnership** Participative approach Partnership **30%**
Innovation and Integration Innovation Integration Replicability **20%**	**Relevance and Feasibility of the Proposed Intervention** Relevance Feasibility **25%**

Scoring Division of the selection criteria

(Source - National Institute of Urban Affairs. (n.d.). *Guidelines for Smart City SPVs,* p. 13. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/CITIIS%20Challenge%20Guidelines%20For%20SPVs.pdf)

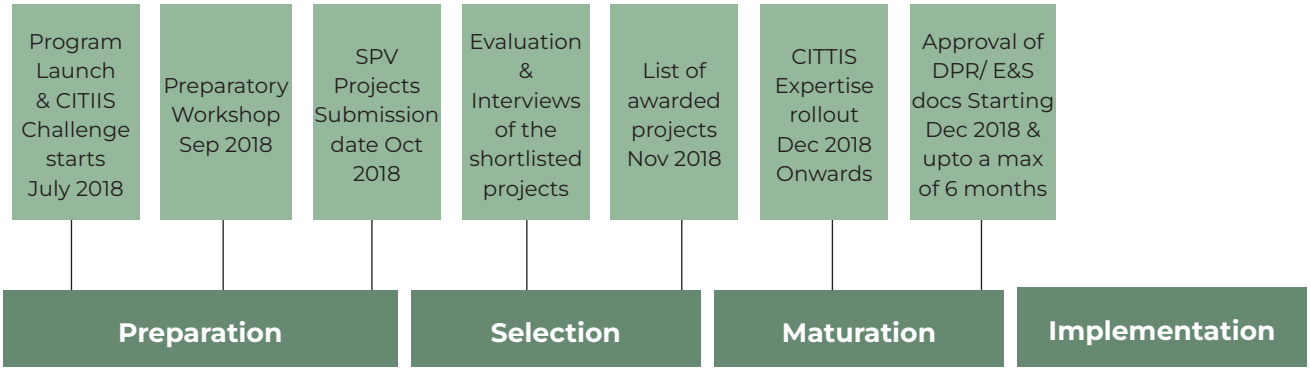
CITIIS Values

(Source - National Institute of Urban Affairs. (n.d.). *Who We Are, City Investments to Innovate, Integrate and Sustain (CITIIS).* Retrieved September 20, 2023, from https://citiis.niua.in/whoweare)

These rigorous procedures resulted in the selection of 12 Smart cities, which are Agartala, Amaravati, Amritsar, Bhubaneshwar, Chennai, Dehradun, Hubbali-Dharwad, Kochi, Puducherry, Surat, Ujjain and Visakhapatnam. These selected cities received financial assistance in the form of a grant and also provided by technical assistance through a three-tier model comprising Six Global Mentors (From India, France, Singapore, Kenya and USA), Six Domestic Experts from diverse areas of expertise like conservation architecture, urban planning

and urban design and transversal experts (EY, TERI and AECOM).

After the selection process, the project maturation period began for the cities in 2019 which was planned to be up to a maximum of 6 months. The maturity framework that the CITIIS program introduced before the project implementation process made it unique from the other initiatives. A 24-step maturation plan was developed to ensure the preparedness for implementation and strengthen the monitoring and evaluation, community engagement and environmental and social safeguards processes. This framework was designed to minimise risks and increase the participation of all stakeholders to ensure that the projects are sustainable financially, socially and environmentally for long-term implementation. Project execution and the procurement procedure began when the maturation period was completed. 18 to 30 months were given to implement each of these projects. (National Institute of Urban Affairs, 2021a)



Process of CITIIS Program

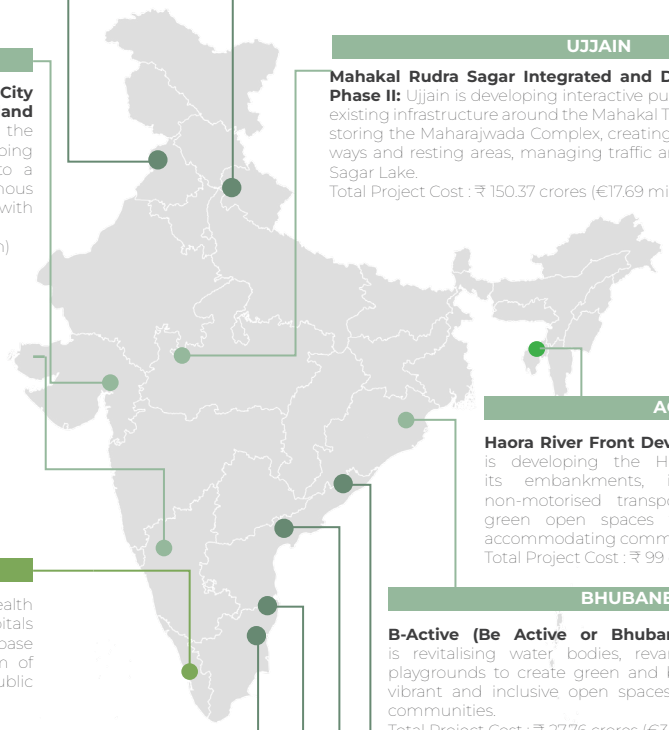
(Source - National Institute of Urban Affairs. (n.d.). *Guidelines for Smart City SPVs*, p. 5. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/CITIIS%20Challenge%20Guidelines%20For%20SPVs.pdf)

The CITIIS initiatives were categorised into four themes: 1. Sustainable Mobility - as it provided safe, affordable, accessible, efficient and resilient services with keeping down the environmental impacts; 2. Public Open Spaces - as it contributed significantly to improve the health and well-being of the people and as well as the general quality of life in the city; 3. Urban E-Governance and ICT - as it facilitated the vital exchange of information and knowledge, enhanced social and territorial cohesiveness, decreases inefficiencies and encourages the network development; 4. Social and Organisational Innovation in Low-Income Settlements - as it created new operational models to address the challenges facing our cities, cultures, and economy. (National Institute of Urban Affairs, n.d.-b)

Thematic Focus Areas

(Source- National Institute of Urban Affairs. (n.d.). *CITIIS - City Investments To Innovate, Integrate, and Sustain.* Retrieved September 20, 2023, from https://citiis.niua.in/)

Selected cities focused on enhancing project sustainability through result-based monitoring and risk management systems, strengthening public participation and project partnership through community-based design and PPP, promoting innovation through open innovation management systems and urban experimentation methods. (National Institute of Urban Affairs, n.d.)



AMRITSAR

Rejuvenation of Autorickshaws in Amritsar through Holistic Interventions (RAAHI): Amritsar is replacing more than 7,000 diesel auto-rickshaws withe-autos to create a convenient yet sustainable public transport system, besides organising drivers in a cooperative society and offering skill training to women in their families
Total Project Cost : ₹ 108.33 crores (€12.74 million)

DEHRADUN

Child-Friendly City project: Dehradun is creating safer pedestrian paths and encouraging the use of public transport to evolve as a friendlier city for school children, the elderly and people with disabilities
Total Project Cost : ₹ 58 crores (€6.92 million)

SURAT

Creating 'Wild Valley Biodiversity Park' as City Lungs by Rejuvenation of Existing Wasteland along the Kankara Creek: Surat is reviving the wasteland along Kankara Creek and redeveloping a stretch of 87 hectares by turning it into a biodiversity park which will preserve indigenous flora and fauna and provide the city's people with green open spaces.
Total Project Cost : ₹ 139.15 crores (€16.37 million)

UJJAIN

Mahakal Rudra Sagar Integrated and Development Approach Phase II: Ujjain is developing interactive public spaces by upgrading existing infrastructure around the Mahakal Temple and Ram Ghat, restoring the Maharajwada Complex, creating pedestrian access pathways and resting areas, managing traffic and revitalizing the Rudra Sagar Lake.
Total Project Cost : ₹ 150.37 crores (€17.69 million)

HUBBALI - DHARWAD

Green Mobility Corridor: Hubbali-Dharwad is transforming the Unkal Nala from a stormwater drain into a vibrant public utility and recreational space by creating an eco-friendly corridor for non-motorised transport, constructing, retaining Walls for the Nala embankment and facilitating improved sewage disposal.
Total Project Cost : ₹ 130 crores (€15.29 million)

AGARTALA

Haora River Front Development (Phase- II): Agartala is developing the Haora riverfront to strengthen its embankments, improve sanitation, facilitate non-motorised transport infrastructure, and create green open spaces for fostering biodiversity and accommodating community activities.
Total Project Cost : ₹ 99 crores (€11.65 million)

KOCHI

E-Health Solution: Kochi is rolling on an e-health implementation solution in government hospitals to create a centralized digital information database and management system, and fulfill its aim of building an affordable and accessible public healthcare system.
Total Project Cost : ₹ 19.13 crores (€2.25 million)

BHUBANESWAR

B-Active (Be Active or Bhubaneswar Active): Bhubaneswar is revitalising water bodies, revamping parks, and developing playgrounds to create green and blue corridors in the city, foster vibrant and inclusive open spaces and build healthy and active communities.
Total Project Cost : ₹ 27.76 crores (€3.26 million)

PUDUCHERRY

Our Neighbourhood is your Neighbourhood too - A Participatory Planning Approach For Improvement of Low-Income settlements in Puducherry : Puducherry is working to provide wider access to affordable housing, upgrade public spaces, promote citizen participation and improve the socio-economic conditions of people in low-income settlements.
Total Project Cost : ₹ 99.71 crores (€11.73 million)

VISHAKAPATNAM

Social Inclusion Through Modernising Public School as Smart Campus: Vishakapatnam is upgrading 40 Greater Vishakapatnam Municipal Corporation schools with the aim of building child-friendly and universally accessible physical infrastructure, adopting smart ways of teaching and creating more inclusive learning environments
Total Project Cost : ₹ 65 crores (€7.65 million)

CHENNAI

Model and Smart Corporation Schools: Chennai is transforming 28 Corporation schools with modern digital and experriental infrastructure to improve students learning environments and outcomes and in turn, create inter-generational impacts of the community.
Total Project Cost : ₹ 95.25crores (€11.21 million)

AMARAVATI

Basic Infrastructure Development in Lo-Income Settlements in Amaravati City: Amaravati is building and retrofitting schools, Anganwadi centres, e-health sub-centers and nodal primary healthcare centres to improve the quality of life in low-income households, besides constructing a multi-faith funeral campus so people can have dignity in death.
Total Project Cost : ₹ 138.62 crores (€16.31 million)

The 12 Selected Projects under the 4 Focus Areas of CITIIS
(Source - National Institute of Urban Affairs. (2023). *CITIIS*. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-08/CITIIS%20One-pager_Aug%202023.pdf)

The program ensured emergence of innovative and participatory initiatives through a detailed and designed maturation and implementation process that addressed the needs of the local residents. The objectives of the maturation phase of these selected cities were based on project structuring, capacity enhancement, stakeholder engagement, mainstreaming of CITIIS values and Evaluation & Monitoring (E&M). (National Institute of Urban Affairs, 2021c)

Project structuring	Maturation Roadmap Project Logical Framework	Baseline Study and Report	Feasibility Study	Finalised PLF Detailed Project Report	Results-Based Management Tool
SH Engagement	Mapping and contact Identification	Stakeholder Engagement Plan	Workshop on Co-design of Scenarios with Stakeholders	Workshop on Scenario selection with CLAF	Communication and Outreach Plan for Implementation
Capacity Enhancement	Otganisational Readiness SPV Staffing Plan	Recruitment of SPV Staff	Training Workshops supported by the PMU	Additional Training Needs Assessment	Capacity-Building Plan Lessons learnt from the Maturation Phase
Mainstreaming of CITIIS Values	Review of Best Practices and Lessons learned	E&S Screening	E&S Impact Assessment	E&S Mitigation measures	E&S Management Plan
		Innovation, Climate Change WS	Workshop on Co-design/ Validation of a Quick Win project	Quick-Win Pilot Project	Maturation Report

Maturation Framework table for the CITIIS Program

(Source - National Institute of Urban Affairs. (2022). *Toolkit for Developing an Effective Communications and Outreach Plan,* p. 5. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2022-12/fFinal_COP_Toolkit_12_November_2020-o-2.pdf)

Knowledge Capitalisation for CITIIS program is developed through 8 different segments. (National Institute of Urban Affairs, 2021c)

1. Project Logical Framework (PLF) is designed as a workbook for project life cycle development for strategic planning of urban projects.

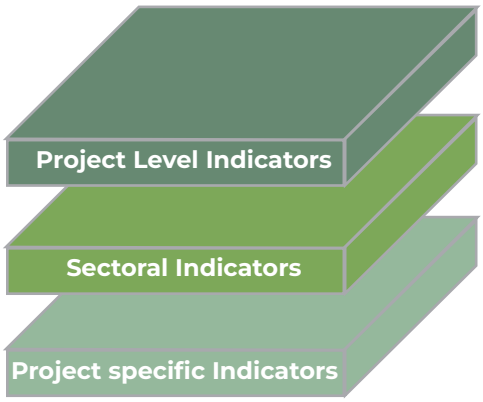
2. Monitoring & Evaluation (M&E) tools and methodologies are created for urban practitioners to find different level indicators of the projects.

Indicator selection methodology is created to choose and categorise with the intention of integrating data and demonstrating the project's overall impact. After the core design is finalized for the project, various practical constraints are used to identify its components and indicators.

Level- 1 Program-level Indicators have the aim of evaluating the program's effects on the social and institutional contexts along with the physical environment.

Level- 2 Sectoral indicators have the aim of evaluating the impact across different impact sectors.

Level- 3 Project-specific indicators have the aim of reflecting upon individual project's outputs, outcomes and impacts.



Three Levels of Indicators

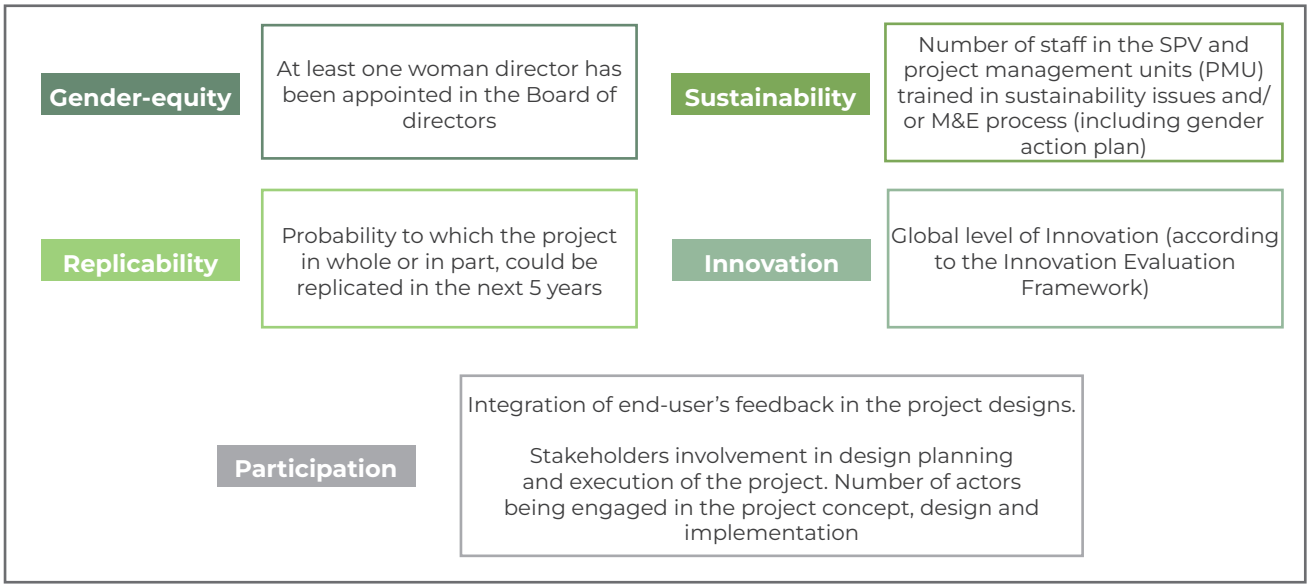
I Mandatory for all projects

II Recommended when appropriate

III SPVs are free to propose additional specific indicators

Three-tier Indicators Selection Methodology

(Source - National Institute of Urban Affairs. (2023). *Monitoring & Evaluation Workbook*, p. 7. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/ME_Workbook_Final.pdf)



Level -1 Program-Level Indicators

(Source - National Institute of Urban Affairs. (2023). *Monitoring & Evaluation Workbook*, p. 8. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/ME_Workbook_Final.pdf)

Output Indicators	New and or refurbished educational facility (including digital infrastructures)	New and or refurbished health facilities (including the implementation of e-health solutions)	Number of new housing units build for people from low-income communities	Access to affordable transport services (public transport - buses and IPTs). Number of km of created or refurbished NMT infrastructures	Public + Green spaces created or refurbished by the project
Level 2 Indicators	Education	Health	Housing	Transportation	Public open spaces
Outcome Indicators	Students benefitting from new and / or refurbished educational facility (including digital infrastructure)	Patients benefitting from new and/ or refurbished health facilities (including the implementation of e-health solutions)	Population benefitting from improved housing	Number of Public Transport Users	Public + Green spaces created or/ refurbished by the project

Level -2 Sectoral Indicators

(Source - National Institute of Urban Affairs. (2020). *Monitoring & Evaluation Workbook*, p. 9. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/ME_Workbook_Final.pdf)

3. Environmental & Social (E&S) management and reports are developed for SPVs to monitor E&S compliance especially for reviewing the implementation of E&S safeguards and plans.

4. Communications and Branding Guidelines for communications, outreach and advocacy materials developed to strategise ways of engaging stakeholders and strengthening brand recognition and visibility.

5. CITIIS Implementation Phase Preparatory Sessions are conducted to provide information on basic approach principles, operational arrangements, stakeholder responsibilities, deliverables and other requirements.

6. SPV Operation & Maintenance (O&M) template is developed to track their activities and adhere to good practices / guidelines / regulations.

7. Toolkit on Urban Infrastructure Project Development consists of proposed tools for each phase in a step-by-step approach for project development. This toolkit helped urban managers ascertain a broader strategic perspective of all the activities at hand that go towards the preparation of an urban infrastructure project. It has 5 stages;

Stage- 1 Project Readiness included Project Roadmap, Project Logical Framework, Organisational Readiness Assessment and Staffing Mapping

Stage- 2 Project Structuring included Global Best Practices Review, Environmental and Social Safeguards Screening, Baseline Studies, Stakeholder Engagement Plan (SEP) and Communications and Outreach Plan (COP)

Stage- 3 Design Feasibility included Environment and Social Impact Assessment. , Feasibility Study Project Scenario Co-design and Pilot Project Implementation

Stage- 4 Design Solution included E&S Management Plan (ESMP), Monitoring and Evaluation Plan and Detailed Project Report (DPR)

Stage- 5 Project Maturity included Additional Training Needs Assessment, Capacity Building Plan, and Design Evaluation Report

8. CITIIS have emphasised that how important local action is in achieving a significant portion of national commitments to the SDGs.

11.1)... access for all to adequate, safe and affordable housing and basic services and upgrade slums

448 Number of new housing units
Over 5,900 population benefitting from improved housing conditions

11.2)By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all.....

12,000 new public transport vehicles
61 kilometers of refurbished NMT infrastructure
300,000 more public transport users per year

11.3).....enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management.....

Over 58,000 stakeholders engaged on projects
60% integration of end-user feedback
Over 16,134 women stakeholder engaged

11.7) By 2030, provide universal access to safe, inclusive, green and publicspaces....

7,068 Hectares a of green space created or refurbished
Over 6,53,000 people with increased accesss to public green spaces
150 Hectares a of public spaces

3.8) Achieve universal health coverage.... and access to safe, effective, quality and affordable essential medicines and vehicles for all

36 new and/or refurbished health facilities
Over 21,500 patients to benefit per year

4.a) Build and upgrade education facilities that are child, disability and .... for all

88 new and/or refurbished educational facilities
Over 26,300 students to benefit per year

4.4) By 2030, substantially increase thenumber of youth and adults wh have relevant skills..jobs and entrepreneurship

Over 100 number of SPV staff trained in sustainability issues and M&E processes

Gender Equity

5.5) Ensure women's full and effective participation and equal opportunities for leadershi at all levels of decision-making in political, economic and public life

All 12 SPVs have atleast one woman director on theirboard
11 projects include at least in part-without it being essential a component about gender equity

Water and Sanitation

6.1) By 2030, achieve universal and equitable access to safe and affordable drinking water for all

Over 10,000 people benefit from access to safe water

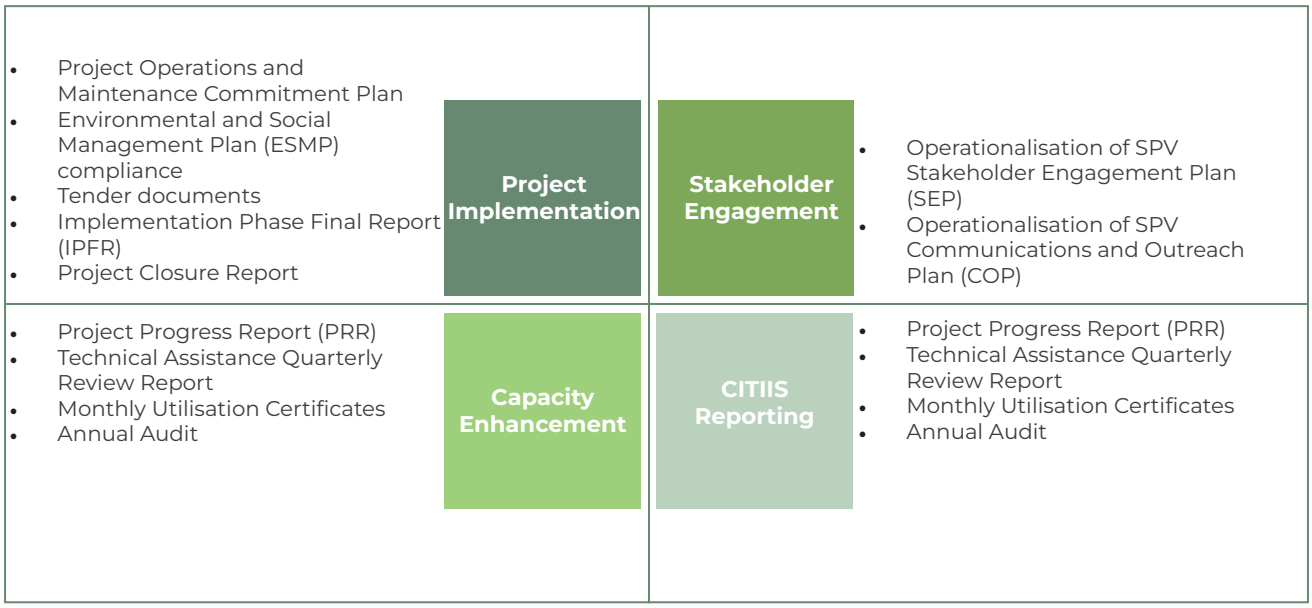
6.2) By 2030, achieve access to adequate sanitation and hygiene for all... those in vulnerable situations

Over 4,018 get improved access to sanitation

Holistic picture of the alignment of the CITIIS program with various SDG targets and goals

(Source - National Institute of Urban Affairs. (2021, June). *CITIIS and the Sustainable Development Goal,* p. 24. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/Final%20CITIIS%20and%20SDG%20Goals.pdf)

These plans and strategies are operationalized in the implementation phase. It included acquiring the project base and its construction, assessing financial management, monitoring project progress, evaluating periodic performance and capitalizing the lessons which are learnt during the course of the project. A crucial component of the implementation phase design was alignment with the creation of the CITIIS Management Platform (CMP), on which project-related activities for the maturation phase have been mapped. All reporting and management activities related to the implementation phase were carried out on CMP using the same design structure.



Implementation Phase Framework for SPVs

(Source - National Institute of Urban Affairs. (2021, March). *Implementation Phase Reference Guide*, p. 15. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2023-02/Implementation%20Reference.pdf)

The CITIIS program has worked on the following initiatives in relation to the four main themes.

1. To serve the demands of the local people, inadequate public transport infrastructure in Dehradun and Amritsar, under the Sustainable Mobility theme, projects have been developed. Projects such as, the improvement of street infrastructure and public transit are undertaken in these cities.

2. To facilitate quality education and adequate infrastructure for low-income settlements, under the theme of Social and organizational Innovation in Low-income Settlements, Amaravati, Visakhapatnam, Puducherry and Chennai cities have developed projects. These projects used institutional and technical frameworks that are inclusive in their design and execution to make sure that the views of all students and residents are heard.

3. To provide open spaces for recreation, cultural activities and non-motorised transport usage Bhubaneshwar, Agartala, Hubballi-Dharwad, Ujjain and Surat cities projects are developed under the theme of Public Open Spaces. By conserving bio-diversity, creating cycling paths and managing crowds these cities are reclaiming available spaces to create breathing spaces in the congested areas.

4. To resolve the lack of integrated health records, the city of Kochi developed the project under the theme of Urban E-Governance & ICT that will consolidate all health records into one cloud-based server. Public healthcare systems are considerably improved by this effort as medical records of all patients of public healthcare will have access to their medical records from any city hospital.

Incorporating the maturation phase, collaborating with public, private and the non-profit sector organizations, involving the community in the process, having regular feedback loops from local residents to field experts, learning from the knowledge sharing and peer-to-peer learning sessions undertaken in the CITIIS program have brought out the different ideas of innovation, integration and sustainability.

According to the United Nations report, by the year 2035 around 675 million will be residing in urban areas which is 43.2%. (The Hindu. 2022) The following data is given to understand the urban pressure and the need of sustainable and innovative projects in the selected cities.

Agartala

Population
4,00,004

Area (sq.km²)
58.84

Density (Persons per sq km)
6798

Ease of living Index Rank (2018)
93

Amaravati

Population
35,52,950

Area (sq.km2)
217.5

Density (Persons per sq km)
16,335

Ease of living Index Rank (2018)
16

Amritsar

Population
11,32,383

Area (sq.km2)
136

Density (Persons per sq km)
8326

Ease of living Index Rank (2018)
76

Bhubaneshwar

Population
8,43,402

Area (sq.km2)
135

Density (Persons per sq km)
6247

Ease of living Index Rank (2018)
18

Chennai

Population
46,46,732

Area (sq.km2)
175

Density (Persons per sq km)
26,553

Ease of living Index Rank (2018)
14

Dehradun

Population
5,69,578

Area (sq.km2)
68.18

Density (Persons per sq km)
8354

Ease of living Index Rank (2018)
80

Hubbali-Dharwad

Population
9,43,788

Area (sq.km2)
213.42

Density (Persons per sq km)
4422

Ease of living Index Rank (2018)
57

Kochi

Population
6,02,046

Area (sq.km2)
107.13

Density (Persons per sq km)
5620

Ease of living Index Rank (2018)
45

Puducherry

Population
2,44,377

Area (sq.km2)
19.54

Density (Persons per sq km)
12,507

Ease of living Index Rank (2018)
60

Surat

Population
44,67,797

Area (sq.km2)
335.82

Density (Persons per sq km)
13,304

Ease of living Index Rank (2018)
19

Ujjain

Population
5,15,215

Area (sq.km2)
92.68

Density (Persons per sq km)
5559

Ease of living Index Rank (2018)
24

Vishakapatnam

Population
17,28,128

Area (sq.km2)
513.61

Density (Persons per sq km)
3,365

Ease of living Index Rank (2018)
17

Population, Area, Density, Ease of Living Index Rank

(Source- National Institute of Urban Affairs. (2022). *Short Listed Project*. Retrieved September 20, 2023, from https://citiis.niua.in/web/sites/default/files/2022-12/SCM_CiITIIS%20Book_23%20Feb_0.pdf)

In the four themes, some of the initiatives were taken indirectly with the concern of climate change, such as, CITIIS strategies in Ujjain include the rejuvenation of water bodies, especially the lakes in the city. This enhances the city's water resilience and emphasise the importance of adaptive water management in a drought-prone city like Ujjain. (CITIIS, n.d.-b) Plantation of natural species to increase carbon-dioxide absorption, oxygen generation and temperature regulation of surrounding areas, interconnection of water retention ponds, maintenance of natural storm water drain etc. measures have been taken in the Surat with regards to air pollution and water management. Agartala CITIIS project aimed at strengthening of the embankment along the river as a flood control measure as the city is highly vulnerable to floods. In Amritsar, E-rikshaws are being promoted to connect the areas such as the historic city with the BRT spine. Polluting diesel auto rikshaws are being replaced by the E-rikshaws. Subscidies are being provided to the rikshaw owners. This would lead to improve the quality of air in the city.

This shows that the program recognizes the significance of sustainable development along with the climate and environmental issues and encourages cities to adopt practices that ensure long-term environmental and social viability. (CITIIS, n.d.-a)

In May 2023, the Union Cabinet approved CITIIS 2.0 for the year 2033 to 2027. CITIIS 2.0 will complement the existing national programmes and schemes such as, National Mission on Sustainable Habitat, Atal Mission for Rejuvenation and Urban Transformation 2.0 (AMRUT), Swachh Bharat Mission 2.0 and Smart Cities Mission, as well as contribute positively to India's Intended Nationally Determined Contributions (INDCs) and Conference of the Parties (COP26) commitments and will augment the climate action initiatives. (Press Information Bureau, 2023)

CITIIS 2.0 comprises three main components, providing financial support and technical assistant for up to 18 smart cities for projects promoting circular economy with a focus on Integrated waste management, providing support to set-up / strengthen their existing state climate centers / cells, creating state and city level climate data observatories, to facilitate climate-data driven planning, develop climate action plans and to build capacities of municipal functionaries, doing interventions center, state and city level, to for climate governance through institutional strengthening, knowledge dissemination, partnerships, building capacity, research and development to support scale up across all States and Cities. (Press Information Bureau, 2023)

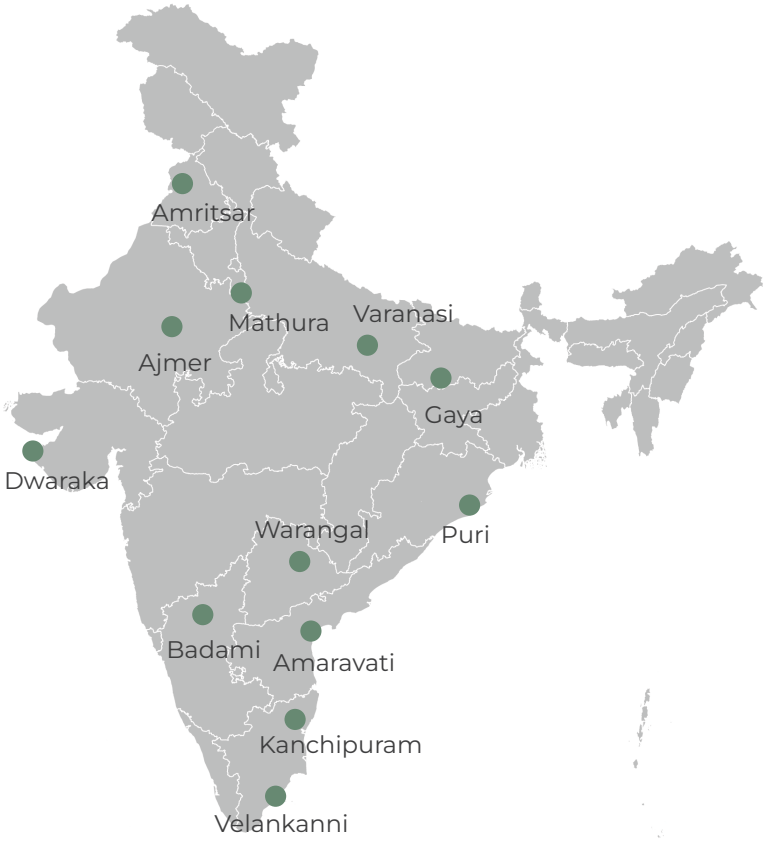
CITIIS program's long-term goal is to gain learning from the selected initiatives and capacity-building measures to increase the positive impacts of the program and make it a substantial contribution to the urban sector in India and beyond. These learnings promise to be benchmarks for good practice in urban planning and project implementation anchored in sound empirical data, stakeholder engagement, communication and participation of communities as a dialogical process, innovation anchored in nature based solutions responsive to climate change. The knowledge products generated in the course of the program are significant learnings and would contribute in the development of the toolkit and MOOC module for this ongoing project on Climate Action for cultural and built heritage in Indian Cities.

Learnings from HRIDAY

The aim of the HRIDAY scheme was to demonstrate conservation of historic and cultural resources in Indian cities and towns with the consideration of needs and aspirations of the local communities and to address urban development issues, such as local economy, urban planning, livelihoods, service delivery, and infrastructure provision. (Ministry of Housing and Urban Affairs, 2015) It was an endeavor to improve the city's planning, basic services, community quality of life, economics and way of life, sanitation, and security, which together helped to revitalize the city's spirit.

The statement of the scheme was 'to preserve and revitalize the soul of the heritage city to reflect the city's unique character by encouraging an aesthetically appealing, accessible, informative and secured environment. To undertake strategic and planned development of heritage cities aiming at improvement in overall quality of life with specific focus on sanitation, security, tourism, heritage revitalization and livelihoods retaining the city's cultural identity.' (Ministry of Housing and Urban Affairs, 2015) To address these important issues in the heritage cities, the program offered recommendations for sustainable, inclusive, and integrated development. The scheme primarily concentrated on infrastructure development in historic areas which were termed as 'heritage zones'. The goal was to 'restore and rejuvenate the soul of the heritage city'. The implementation strategy was expected to be program-based rather than project-based; this approach differs from earlier plans of the Ministry of Ministry of Housing and Urban Affairs.

Twelve heritage cities were identified by the central government from across the country. These were Ajmer (Rajasthan), Amaravati (Andhra Pradesh), Amritsar (Punjab), Badami (Karnataka), Dwarka (Gujarat), Gaya (Bihar), Kancheepuram (Tamil Nadu), Mathura (Uttar Pradesh), Puri (Odisha), Varanasi (Uttar Pradesh), Velankanni (Tamil Nadu), Warangal (Telangana). (Ministry of Housing and Urban Affairs, 2015) Cities selected under the HRIDAY Scheme served as excellent examples of the inextricable relationship between these historic cities and their cultural roots.



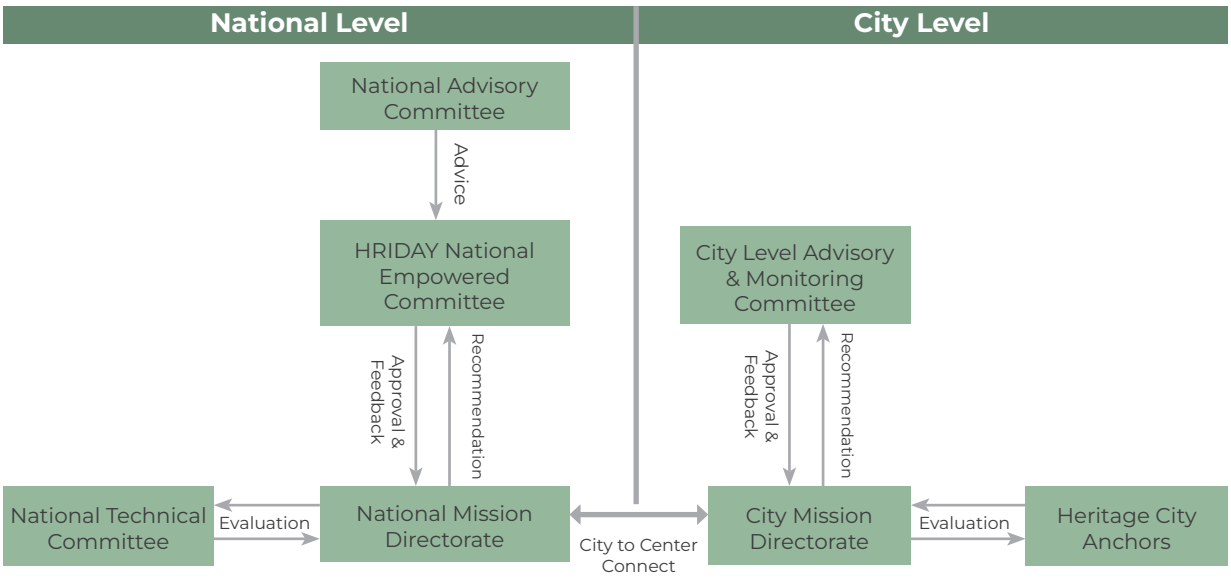
HRIDAY Cities

(Source - National Institute of Urban Affairs. (n.d.). *HRIDAY Guidelines,* p. 13. Retrieved September 15, 2023, from https://smartnet.niua.org/sites/default/files/resources/hriday_Guidelines.pdf)

Several specific objectives were outlined in this program which included planning, developing, and implementing heritage-sensitive infrastructure with the aim to preserve and revitalize heritage sites, enabling tourists to connect directly with the unique character of the city. Additionally, the program focused on improving basic services, particularly sanitation, and enhancing local capacity for an inclusive heritage-based industry. It also sought to establish effective connections between tourism and cultural facilities, conserve natural and built heritage and promote adaptive rehabilitation and maintenance of urban heritage, incorporating suitable technologies for historic building retrofitting. Furthermore, the program aimed to facilitate public-private partnerships for adaptive urban rehabilitation, make cities more informative through modern ICT tools, enhance security with modern surveillance and security systems like CCTV, and improve overall accessibility, encompassing physical and intellectual aspects, such as road infrastructure and digital mapping of historical locations and tourist routes.

HRIDAY program provided a general list of indicative components through documentation and mapping of heritage assets leading to heritage management plans, heritage revitalization linked to service provision, city information/ knowledge management and skill development; however, these components were modified to meet the specific needs of the city. (National Institute of Urban Affairs (NIUA, n.d.) The program was divided into three levels of procedure - Project Preparation, Project Appraisals, Project Implementation. Finance allocation, expenditure structure and review processes were all included in the program as discrete, manageable components that could be handled by both central and local organizations. (National Institute of Urban Affairs (NIUA), n.d.)

The National Institute of Urban Affairs (NIUA) was designated as the National Project Management Unit (NPMU) for the HRIDAY Scheme and worked as a secretariat for the Mission Directorate housed in the Ministry of Housing and Urban Affairs. The unit was responsible for preparation of HRIDAY guidelines, monitoring and managing the overall program and doing capacity building programs for stakeholders. A National Technical Committee was appointed for technical review, evaluation of implementation frameworks and detailed project reports. Consultancy firms were appointed through a public procurement process which required them to be specialists in heritage conservation planning, with significant experience in working in the respective state/s and the city under consideration. The appointment of the consultants was based on technical evaluation with a fixed predetermined fee (competition between the bidders was on technical parameters only). The consultants were called HRIDAY City Anchor/s (HCA). Further, consultants were separately appointed to prepare the Detailed Project Reports for the projects scoped in the City HRIDAY Plan.



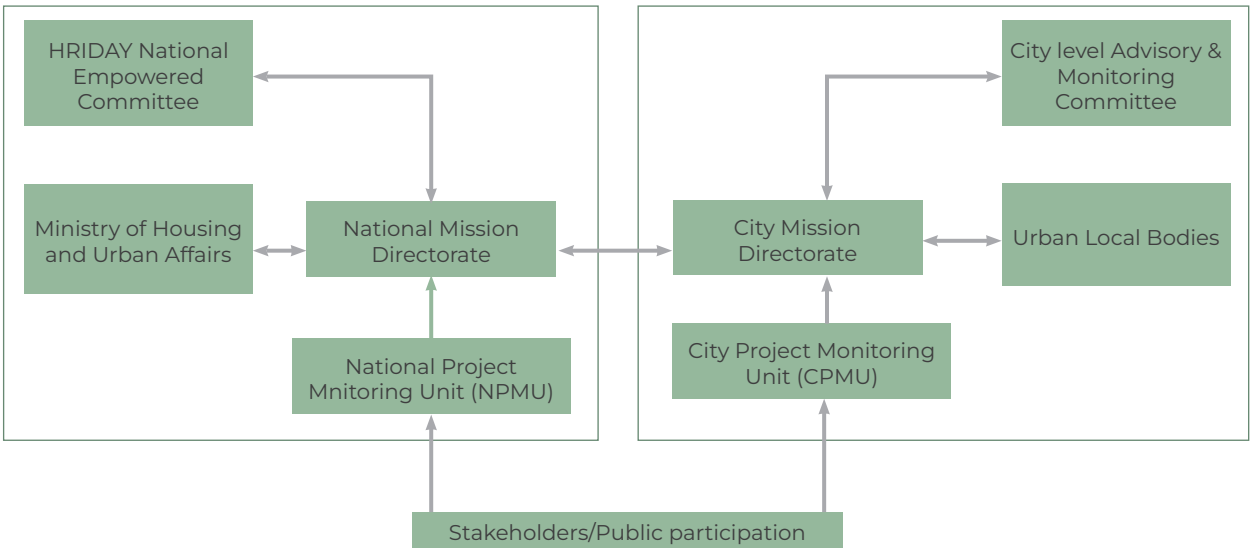
Institutional Framework

(Source- International Council on Monuments and Sites (ICOMOS) and Centre for Environmental Planning and Technology (CEPT). (2017). *HRIDAY Reflections, A Monograph on the Heritage City Development and Augmentation Yojana*, p. 78. Retrieved September 15, 2023, from https://www.academia.edu/42082970/HRIDAY_Reflections_A_Monograph_on_Heritage_City_Development_and_Augmentation_Yojana)

A City Level Advisory and Monitoring Committee (CLAMC) was created in each of the 12 cities which was the decision making body and comprised of representatives and officials from the urban local body, political representatives from the city, NGOs and individuals of considerable repute in heritage, architecture, urban

planning etc. from the city. The chairperson of CLAMC was the Municipal Commissioner or the district head, the Deputy Commissioner. The Municipal Commissioner was the designated City Mission Director and the City Mission Directorate, the nodal agency for implementation of the program, was housed in the Urban local body . The City Mission Directorate appointed a nodal officer who was responsible for coordinating evaluation of the City HRIDAY Plans, Detailed Project Reports (DPRs), executing and monitoring works along with vetting of M&E Certificates and release of payments to executing agencies.

The primary objective of the HRIDAY City Anchors was to handhold the cities in successful implementation of the scheme, which included providing technical advisory and guidance to the City Mission Directorate, prepare the City HRIDAY Plans, prioritize projects, provide quality control for all selected projects from preparation of Detailed Project Reports to execution of works. They were responsible for undertaking capacity building programs of stakeholders engaged in the project. They were required to prepare concept design for a City Museum and a Toolkit with design guidelines and material specifications for interventions in public spaces. A wide range of professional community of urban planners, conservation architects and heritage site managers were brought together to take part in this national level historic city mission. (ICOMOS and CEPT, 2017)



Implementation Framework

(Source- National Institute of Urban Affairs. (n.d.). *HRIDAY Guidelines*, p. 5. Retrieved September 15, 2023, from https://smartnet.niua.org/sites/default/files/resources/hriday_Guidelines.pdf)

As mentioned above, the City HRIDAY Plan/s (CHP) were prepared by the city anchors. This city level plan was prepared after mapping of cultural heritage within the city. The intent of this plan was creation of a sustainable Civic Infrastructure Development Plan (CIDP) with identified gaps in the city's infrastructure and basic amenities through application of locally applicable standards / norms / bye-laws. Regulatory framework was provided for water supply, sanitation, drainage, waste management, approach roads, footpaths, street lights, tourist conveniences, electricity wiring, landscaping etc. around tangible heritage assets.

Considerable flexibility was provided to the city anchors to determine the nature of projects for the cities. While some of the anchors considered the entire inner cities for strategizing the City HRIDAY plan, others considered only precincts or neighbourhood level. The commonality however was that each city identified at least one religious / historical structure / shrine as the central focus and developed different approaches to enhance the surrounding areas. Through HRIDAY scheme a variety of projects were undertaken in the historic areas such as, revival of water bodies (lakes, kund, ghats, river fronts etc.), conservation and adaptive reuse of buildings of heritage significance, landscaping and environmental improvement in historic open spaces, parks and gardens, provision of public facilities (drinking water points and toilets), improvement in solid waste management , augmentation of stormwater management, improvement in sewerage and sanitation, conserving and reviving groundwater recharge, providing rain water harvesting / recharge pits, provision of green energy , development of nature and cultural heritage-based heritage trail, promoting eco-tourism, providing city-level eco-friendly mobility, facilitating street infrastructure (benches, lights, bollards, pavement, signage etc.), development of pradakshina / procession / sacred paths etc. The HRIDAY city anchors were required to provide a comprehensive list of projects for their cities without considering the allocated funds under this program. This was to enable the city to continue implementing the identified projects over time in the interest of sustainable conservation and management of the city's cultural and natural heritage and not be limited by the resources made available under this one program.

The government invested a total INR 500 crore for this initiative. (ICOMOS & CEPT, 2017) The funds are to be released to executing agencies by MoUD. The total annual allocation is utilized as per the table given here.

The funds are released on performance basis -

20 % on approval of project 1st installment
60 % on 20 % physical and financial progress of the project
20 % on 60% physical and financial progress of the project

Components	% Of Total Funds
HRIDAY Cities Project Implementation	85%
NPMU/ City PMU Establishment & operationalization at MoUD/ City	3%
Capacity Development for Heritage Cities	3%
DPRs and Development/ Management Plans	4%
IEC	4%
A & CE	1%

City	Budget
Amaravati	22 Crore
Ajmer	40 Crore
Warangal	40 Crore
Varanasi	89 Crore
Velankanni	22 Crore
Puri	22 Crore
Gaya	40 Crore
Badami	22 Crore
Amritsar	69 Crore
Dwaraka	22 Crore
Kanchipuram	23 Crore
Mathura	40 Crore

Fund allocation organized according to components outlined in the framework of the scheme and city-wise fund distribution

(Source- International Council on Monuments and Sites (ICOMOS) and Centre for Environmental Planning and Technology (CEPT). (2017). *HRIDAY Reflections, A Monograph on the Heritage City Development and Augmentation Yojana,* p. 81. Retrieved September 15, 2023, from https://www.academia.edu/42082970/HRIDAY_Reflections_A_Monograph_on_Heritage_City_Development_and_Augmentation_Yojana)

Each city identified and developed various heritage zones. These zones had specific significance and attributes. Hence, the objectives and strategies to promote heritage conservation, tourism, and overall urban development varied between zones. For example, under HRIDAY scheme, Puri had three heritage zones i.e. Shankha Khsetra Heritage Zone, River Musa Environmental Zone, Balukhanda Recreational Zone. Projects in Shankha Kshetra Heritage zone focused on the conservation and regeneration of built heritage, promotion of heritage tourism and cultural activities as the area encompassed Shri Jagannath Temple and other heritage structures. The River Musa Environmental Zone dealt with the rejuvenation and sustainable management of the water resources and ecosystems in and around Puri. Balukhanda Recreational Zone focused on upgradation of basic infrastructure and recreational facilities on the seafront. The projects in the three zones included improvement of streetscapes, retrofitting of building facades around Parikrama path, landscape development of gardens along with the revitalisation of the ponds of Jagagharas, conservation and facility upgradation in two Mathas. Heritage conservation and environmental aspects of the historic town was the primary focus, which demonstrated a holistic and integrated approach to city development, environmental sustainability which benefits the historic fabric within the town, the local community and visitors. By integrating heritage conservation with sustainable development, the Puri HRIDAY plan showcased Puri's cultural and natural heritage significance, supported its economic growth, and directed an environmentally responsible future of the city for its inhabitants. (CRCI Pvt. Ltd, 2016)

In the HRIDAY plan for Amritsar, the initiative took a 'city based' approach and included the historic walled city with the sacred site of Sri Harmandir Sahib (Popularly known as the Golden Temple) at its center surrounded by traditional neighborhoods as the Zone 1 called Ramdaspur Heritage Zone. It further identified the road encircling the walled city, the circular road, as Zone 2. It identified this as a heritage zone as the road has a critical impact on the walled city and was created to service it during the colonial period and continues to do so. The Gobindgarh fort, the historic fort of Amritsar and its setting was identified as Zone 3, the Rambagh garden, the largest public open green space, also a historic precinct protected by ASI along with its buffer was delineated as Zone 4. Lastly, 40 khuh, which epitomizes the 'water heritage' of Amritsar was designated as the Zone 5. Interventions towards ecological consciousness through provision of softscape / green islands or belts and rainwater harvesting/ recharge pits, green pockets linked with rainwater harvesting, provision of drinking water facilities and public toilets were included in all zones. Ramdaspur Heritage Zone dealt with the comprehensive road development and upgradation of 21 major roads leading to the Golden Temple. Rambagh Garden Recreational Zone focused on conservation and adaptive reuse, edge definition of Char Bagh, multi-dispersed parking, improved visitor facilities, amenities, interpretative materials and landscape. Reorganizing connectivity and linkages through streetscape and landscape improvement at Gol Bagh, comprehensive

improvement of a mobility corridor along the outer and inner circular road, revitalization and infrastructure development at 40 Khuh, or 40 wells and the colonial period powerhouse and development of an environmental park at the UBDC Canal were some of the projects included in the Amritsar HRIDAY city plan. Amritsar is a repository of spiritual heritage for the Sikh community, which comprises sacred spaces / religious shrines / centers, markets, palaces, forts, archaeological sites, memorials and gardens. These spaces are also associated with festival celebrations, large social gatherings, religious and cultural practices, folk songs / dance and traditional sports. The aim of the HRIDAY toolkit for Amritsar was to provide a design vocabulary for interventions in the streetscape to achieve a 'cohesive historic cultural environment' for an improved experience of public spaces for local residents and visitors/ tourists. Further, projects were also identified as part of an integrated strategy for mobility within the city thus easing vehicular and pedestrian movement in and around the walled city. A concept for a comprehensive stormwater management plan was prepared to address the challenge of water logging in the inner city during the monsoon season and to address depleting ground water in the city. Non Motorised transport plan was conceptualized for the walled city based on an assessment of the road widths, circulation etc. so as to improve the quality of life of the users and the residents as well as to achieve reduction in air pollution. (CRCI Pvt. Ltd, 2016)

HRIDAY city plan for Dwarka was developed as a precinct level project. Areas of the city which house significant tangible and intangible heritage were identified. Heritage zones included the forecourt of Dwarkadhish temple, vegetable market, Siddheshwar Mahadev, street from ISKON gate to Dwarkadhish temple and street from Teen Batti to Dwarkadhish temple. Improvement in the civic infrastructure in the Dwarkadhish temple square was one of the key projects. Further, design guidelines were prepared for coherent development around the square and the vegetable market square so as to redeem it as a public space. Quality of public space was further enhanced by segregating vehicular and pedestrian traffic. Siddheshwar Mahadev precinct was provided with civic amenities for monks, residents and visitors. The main processional street (Darshan Path) from Iskon Gate to Dwarkadhish Temple and Teen Batti to Dwarkadhish Temple were pedestrianized (by limiting vehicles). (Urban Management Centre, 2016)

Broadly, all cities considered larger areas for mapping of cultural and natural heritage and designation of heritage zones while projects for interventions were envisaged within historic precincts. These initiatives under the HRIDAY scheme can be said to be the first steps in the history of urban development in India which was geared to achieve enhanced built and cultural heritage at an urban scale. Further, these interventions certainly contributed to growth in the local economy building towards a sustainable future for these historic cities. Capacity building of the urban local bodies in heritage conservation and management were certainly one of the key outcomes of the program.

HRIDAY project initiatives indirectly address climate change related issues in addition to developing infrastructure of these sacred cities. For example, For example, Amritsar city has strategies for stormwater management (surface and underground), improvement in sewer, tree planting zones, which will help in the flooding situations. Puri city has proposed managing traffic to control noise and air pollution, creating a green flood zone, improving drainage facilities and sewage treatment plants, addition of tree planting areas, these are beneficial in cases of floods and cyclones. Ajmer-Pushkar city has plans to improve and restore the lake ecology and ghats. Upgrading water bodies and drains will help in water scarcity of the region. The city of Dwarka has stormwater management and landscape development strategies that are helpful during floods. Varansai city has proposed the de-siltation of ghats, revival of kunds, cleaning and development of nala and riverfront, improvement in groundwater recharge, stormwater drainage, solid waste management and sewerage. These initiatives will prevent the ghats and riverfront from flooding. Badami city has plans for landscaping, de-siltation of tanks/ feeder channels, revitalization of natural landscape and its eco-system, improvement in sullage treatment, surface drainage system, which will help to manage water systems of the city. The city of Gaya has suggested the development of ghats, revival of the lakes, plantation and landscaping. These strategies will help this area that is vulnerable to drought. Warangal city has strategies for the protection of biodiversity and regulating the development around the lake. This will support the city's water system and its water infrastructure.

It is important to note that the learnings from the HRIDAY scheme can significantly contribute in designing policy and programs for historic cities anchored in heritage responsive planning and design for climate action through mitigation and adaptation.

Existing Frameworks, Methodologies and Toolkits for Climate Change

To develop a framework and a toolkit for climate action for cultural heritage in Indian cities, desk-based research has been done to identify existing frameworks, methodologies and toolkits developed by international organisations operating within the heritage or cultural heritage sector, specifically ICOMOS, UNESCO and ICCROM that can be utilized for the purpose. In this process, several resources prepared by other organisations or collaborations between different organisations have also been identified. Selected resources, though developed for specific national or regional heritage contexts, have been found to be thematically relevant for the purpose of this project and therefore have been included.

The preliminary desk-based research and the webinar 'Climate Action, Built and Cultural Heritage in Indian Cities' organised by the project team, indicate three kinds of existing resources:

- Category 1: Frameworks, methodologies and toolkits for climate action
- Category 2: Frameworks, methodologies and toolkits for specific steps within the entire process of conservation and management of cultural heritage (this can be utilized to integrate the question of climate change within existing methodologies of heritage conservation and management)
- Category 3: Doctrinal texts, guidelines and best practice examples of climate change, impacts, action and related themes

Owing to the broad range of documents and information found and considering the purpose and scope of this project, directly relevant resources from the first two categories mentioned above have been listed in this section. Selected resources in the third category mentioned above have been provided in the section of 'Bibliography of Relevant Literature'.

Frameworks, methodologies and toolkits for climate action

Future of our Pasts: Engaging Cultural Heritage in Climate Action

This report of 2019, prepared under the scientific leadership of the Climate Change and Heritage Working Group (now called Climate Action Working Group) of ICOMOS provides an overarching vision of how climate change impacts or can impact cultural heritage and ways in which cultural heritage can contribute to climate action. The document acknowledges that climate change is one of the most rapidly growing threats to people and their heritage across the world, which is creating new kinds of risks for cultural heritage and multiplying existing risks. The document highlights that the diversity and interconnectedness of climate change impacts must become baseline competence for the entire cycle of heritage management, similar to the principles of sustainable development (p. 16). This emphasises the need for adapting existing heritage conservation practices and methodologies of heritage management to address the complex challenges of climate change.

In the section on 'Heritage Tools and Methodologies' (p. 21), the document has provided the suggested requirements for a 'methodological toolkit' that recommends use of existing methodologies and slight adaptations as well as new multi-disciplinary or interdisciplinary approaches to integrate the questions of climate change and climate action for different kinds of assessment within the entire cycle of heritage management. This includes processes of preparing heritage inventories, heritage documentation and monitoring, heritage values and significance assessment, heritage impact assessments (HIA), vulnerability and risk assessment at macro as well as micro scales, climate vulnerability index (CVI), conservation management planning and adaptation planning.

The document builds on diverse documents to summarise the types of drivers of climate impacts and examples of expected effects on heritage (pp. 68-70). The understanding gained through the summary is finally utilised to provide a framework to methodically record and co-relate climate change drivers with six categories of cultural heritage. The categories considered are: moveable heritage, archaeological resources, buildings and structures, cultural landscapes, associated and traditional communities and intangible cultural heritage (pp. 73-89). It is clearly mentioned that there may be a complex interplay between different climate

drivers and that the framework is not comprehensive, rather an indicative guide to the diversity of ways in which cultural resources can be impacted. Steps for a good conservation practice as well as guidelines for pathways for adaptation, mitigation as well as addressing loss and damage are provided in this document.

Climate Vulnerability Index (CVI) for WH Properties

The Climate Vulnerability Index (CVI) Tool has been mentioned as one of the tools in the suggested requirements for a methodological toolkit in the ICOMOS Report 'Future of our Pasts: Engaging Cultural Heritage in Climate Action'. As mentioned in a dedicated website on CVI (n.d.), the tool was developed by Dr. Scott Heron and Dr Jon Day for the purpose of assessing the impacts of climate change on all types of World Heritage Properties across all the ten criteria for inscription. The tool is a combination of value-based, community-led and scientific data driven assessment of sites. As mentioned on the website, in this tool, assessment is carried out in 2 stages:

- The OUV Vulnerability (OUV - Outstanding Universal Value, the central concept for World Heritage) wherein the exposure, sensitivity and adaptive capacity of the key World Heritage values that collectively comprise the OUV are assessed and how they will be impacted by three key climate drivers chosen to be the most relevant for that World Heritage property are evaluated.
- The Community Vulnerability is assessed, based on the economic, social and cultural dependencies upon the World Heritage Property, along with assessing the adaptive capacity of these to cope with climate change. The Community Vulnerability component is a key aspect that makes the CVI distinct from other risk assessment approaches.

Reports on application of the CVI tool on a range of sites till now are available on the website as resources. Currently reports on eleven different heritage sites including both, natural and well as cultural heritage sites are available. The framework is continuously being tested, developed and adapted for application, utility and long-term value across diverse heritage contexts.

Dr. Will Megarry, provided an overview of the CVI Tool in the Webinar on 'Climate Action, Built and Cultural Heritage in Indian Cities', wherein he presented information about the tool in his capacity as the Principal Investigator on the CVI Africa Project. The CVI Africa Project applied the Climate Vulnerability Index tool for the first time in an African context. Two different World Heritage sites were chosen for this – 'Ruins of Kilwa Kisiwani and Ruins of Songo Mnara' in the United Republic of Tanzania, and the 'Sukur Cultural Landscape' in Nigeria. The project had a training component and a practice component of workshops to prepare a CVI assessment of both sites. Reports of the application of the tool are available on the CVI website and the CVI Africa website.

A Climate Change Risk Assessment of the Properties in Care of Historic Environment Scotland

This document published by Historic Environment Scotland in 2018 is an example of a methodology used for climate change risk assessment in a national context. The document provides the results of a baseline assessment of the impacts of natural hazards to the properties in care of Historic Environment Scotland. The purpose of the study was to inform a climate change risk assessment of the properties and is the first step within a comprehensive process to understand, monitor and manage environmental risk to the properties. The document identifies the hazards, calculates risk scores with risk description and likelihood levels, and provides information regarding the properties, which hazards impact them and assigns risk scores to them. The methodology to arrive at this is provided in the document.

Adapt Northern Heritage Toolkit: Assessing Risks and Planning Adaptation Guidance on Managing the Impacts of Climate Change on Northern Historic Places

Adapt Northern Heritage (n.d.) is a project that had the aim of adapting northern cultural heritage to the impacts of climate change and associated natural hazards through the process of community engagement and conservation planning. The toolkit developed in the project is an example of a common framework developed for a regional understanding (in this case historic places in the northern region) of the impact of climate change on historic places towards climate action, taking into account cultural, economic, environmental and social sustainability.

The tool was developed to test and demonstrate the methodology through nine case studies, in Iceland, Ireland, Norway, Russia, Sweden and Scotland, for which adaptation action plans were produced. The places selected as case studies include a diversity of tangible heritage, location and climates (mostly arctic, sub-arctic and temperate oceanic).

The toolkit consists of five tools. The primary tool is a guide for assessing risks and planning adaptation solutions published in 2020, supplemented with a workbook and tutorials. This guide uses the methodology of a cyclic risk assessment process and adapts it for assessing the impacts of climate change. The other four tools are: adaptation stories, conservation factsheets, information sources and climate change risk management and adaptation plans for project case study sites.

The project duration was from June 2017 to May 2020. The project, with Historic Environment Scotland as the lead partner, was a collaboration of several project partners as mentioned below:

- 4 Project Partners: 1. Historic Environment Scotland, 2. Minjastofnun Íslands (the Cultural Heritage Agency of Iceland), 3. Norsk institutt for kulturminneforskning (Norwegian Institute for Cultural Heritage Research), 4. Riksantikvaren (Norway's Directorate for Cultural Heritage)
- 11 Associated Partners from Iceland, Ireland, Norway, Russia, Scotland and Sweden
- Supported by Iceland, Norway and the European Union through the Interreg programme for the Northern Periphery and Arctic.

Selected existing methodologies/ toolkits that can be utilised to integrate the questions of climate change and climate action within the entire cycle of heritage management

A comprehensive conservation management process or cycle typically includes steps such as – understanding the heritage, site and the context; assessing the values and significance; identifying issues, gaps and future aspirations; preparing strategies for conservation and/ or management; and periodic monitoring. The suggested 'methodological toolkit' in the 'Future of our Pasts: Engaging Cultural Heritage in Climate Action' report as mentioned above includes several kinds of assessment within the entire process of heritage conservation and management. Heritage Impact Assessments (HIA), Risk Assessment and Conservation Management Planning are existing methodologies that have been recommended to be adapted to include the question of climate change. This section lists the toolkits available for each of these three methodologies to provide a base for necessary modifications for applicability to address the issue of climate change.

Heritage Impact Assessment (HIA)

The primary framework available to conduct Heritage Impact Assessments is the 'Guidance and Toolkit for Impact Assessments in a World Heritage Context' jointly developed and published in 2022 by UNESCO, ICCROM, IUCN and ICOMOS. Recognising that World Heritage Properties are increasingly being impacted by diverse types of development projects within and around the sites, this document provides a framework for conducting heritage impact assessments for cultural and natural heritage sites, before proceeding with implementation of the proposed projects.

Risk Assessment

For risk assessment, four existing resources that can be utilised and adapted for assessing the impacts of climate change are mentioned here.

The first document, 'A Guide to Risk Management of Cultural Heritage' collaboratively published by ICCROM and Government of Canada, Canadian Conservation Institute in 2016 provides a detailed methodology for risk examination and assessment for cultural heritage. It is aimed to enable cultural heritage professionals and institutions to design intervention plans for risk management of cultural heritage based on the well-informed risk assessment. The guide is supported with examples and illustrations. Though emerging from a museum management background, the recommended tools can be applied for varied types of cultural heritage. Terminologies used for varied types of heritage and disaster risk reduction contexts may vary from those used in this guidebook.

The second resource, 'Managing Disaster Risks for World Heritage' jointly published by UNESCO World Heritage Centre, ICCROM, IUCN and ICOMOS in 2010, provides the principles of Disaster Risk Management (DRM) for heritage and a methodology to identify, assess and mitigate disaster risks. The resource is primarily designed as a guidance for site managers and management authorities of cultural and natural World Heritage properties to reduce risks to the properties from natural and human-induced disasters.

The third document, 'First Aid to Cultural Heritage in Times of Crisis' is a handbook jointly published by ICCROM and Prince Claus Fund for Culture and Development in 2018 for co-ordinated emergency preparedness and response to secure tangible and intangible heritage. It explains the steps for cultural heritage first aid to secure cultural heritage during large-scale disasters (emergency/ crisis) situations. The immediate actions needed to reduce risks and stabilise endangered tangible and intangible cultural heritage towards the aim of recovery are provided in the toolkit through a three-step actionable framework, designed to be adapted to different disasters and their specific contexts.

The participatory game approach outlined in the fourth document, 'inSIGHT: A Participatory Game Capturing Community Held Knowledge for Disaster Resilience and Sustaining Heritage' developed by ICCROM and published in 2020 provides a framework to identify and use traditional knowledge held by local communities towards reducing disaster risks. The game method is to collaborate and engage with people from varied community groups towards learning and acting together.

Conservation Management Planning

Two toolkits that provide methodologies for conservation management planning are elaborated here.

'Enhancing Our Heritage Toolkit: Assessing Management Effectiveness of Natural World Heritage Sites' published by UNESCO World Heritage Centre in 2008 is the result of efforts and co-operation of UNESCO World Heritage Centre, IUCN and other partners to develop a World Heritage site management tool. The toolkit contains twelve practical tools supplemented with exercise worksheets and guidelines, designed to assist in the preparation of a comprehensive management framework. The toolkit emphasises adaptability to local contexts. Though developed with a focus on natural properties, the document mentions that the toolkit is valuable to assist with cultural properties as well.

'The HUL Guidebook: Managing Heritage in Dynamic and Constantly Changing Urban Environments' published by WHITRAP in 2016 is a practical guide to UNESCO's Recommendation on the Historic Urban Landscape (HUL). The guidebook serves as a supplement to assist stakeholders towards a better understanding of recommendation, to aid better application of the four tools of the recommendation and their adaptation for local contexts through provision of case studies illustrating varied applications.

Framework for Recording Case Studies

A framework for recording case studies has been developed to ensure that the information is presented in a distilled manner with key takeaways.

The framework broadly covers 3 profiles:
Heritage Profile - Covering the significance of the case study through a climate lens.

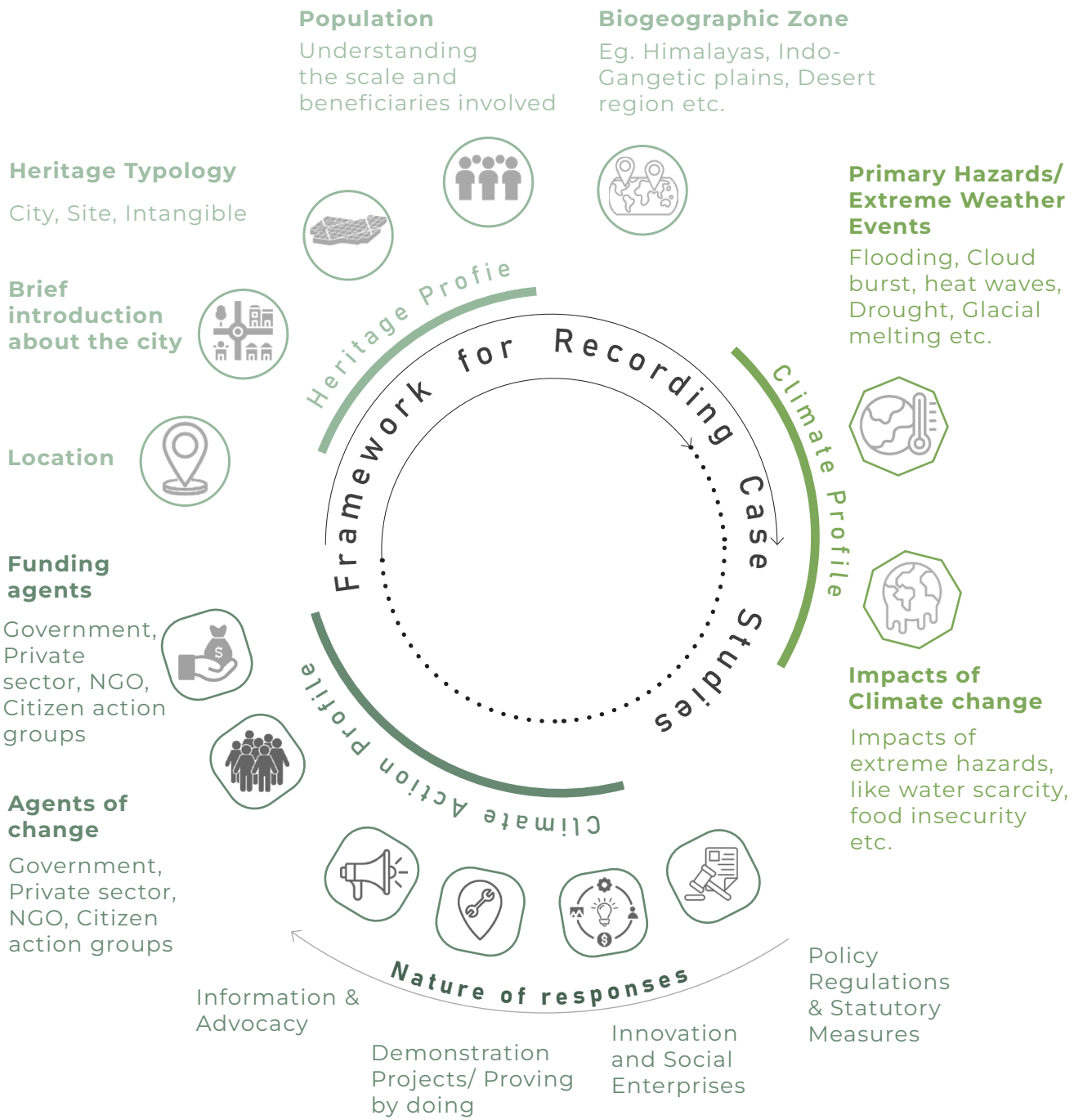
Climate Profile - Covering the climate profile, primary hazards as well as the impact of climate change on the case study.

Climate Action Profile - Covering the interventions made with regard to climate action.

The interventions are specifically classified under 4 categories-

- Information & Advocacy
- Demonstration Projects
- Innovation and Social Enterprises
- Policy Regulations & Statutory Measures

The diagram in the facing page elucidates the various components of the framework. The framework is designed to provide explicit learnings from the case studies in the form of a spatial and searchable database as well as implicit learnings from the case studies in the form of enablers and barriers for climate action.



Framework for recording case studies

Part B

Cases for Climate Action

City

03 Historic Centre of Prague, Czech Republic

05 WHC Climate Change Adaptation and Mitigation-Paris Climate Protection Plan, Paris

06 WHC Climate Change Adaptation and Mitigation-Edinburgh, Scotland

07 WHC Climate Change Adaptation and Mitigation-Plan Verde, Mexico city

08 WHC Climate Change Adaptation and Mitigation-Hué, Vietnam

11 Ark for Iraq

15 The MOVIDA Project, Italy

16 George Town, Penang, Malaysia

17 Rotterdam, Netherlands

18 Santo Domingo Tehuantepec, Mexico

20 Venice, Italy

22 Ayutthaya City, Thailand

23 Dubrovnik iDEAL Project, Croatia

24 Post Disaster Assessment, Floods & Landslides, Kerala

25 3D for Heritage India, Kutch

Site

01 Parivartan - Holistic Rural Development Project, India

02 Chan Chan Archaeological zone, Peru

04 Timbuktu, Mali

10 Denso Hall Rahguzar (Walking Street) Eco Enclave, Karachi

12 Climate Change Adaptation and Mitigation in Lamu Old Town, Kenya

13 Sukur Cultural Landscape, Nigeria

14 Traditional Oases agriculture in M'Zab Valley, Algeria

19 Stepwells, Rajasthan, India

21 Princeville, North Carolina, USA

Intangible

09 Traditional Wooden Building Techniques of Japan

1 Parivartan – Holistic Rural Development Project

Location	Typology	Population	Bio-geographic Zone
Sagar Island, India	Site	2,12,037	Islands

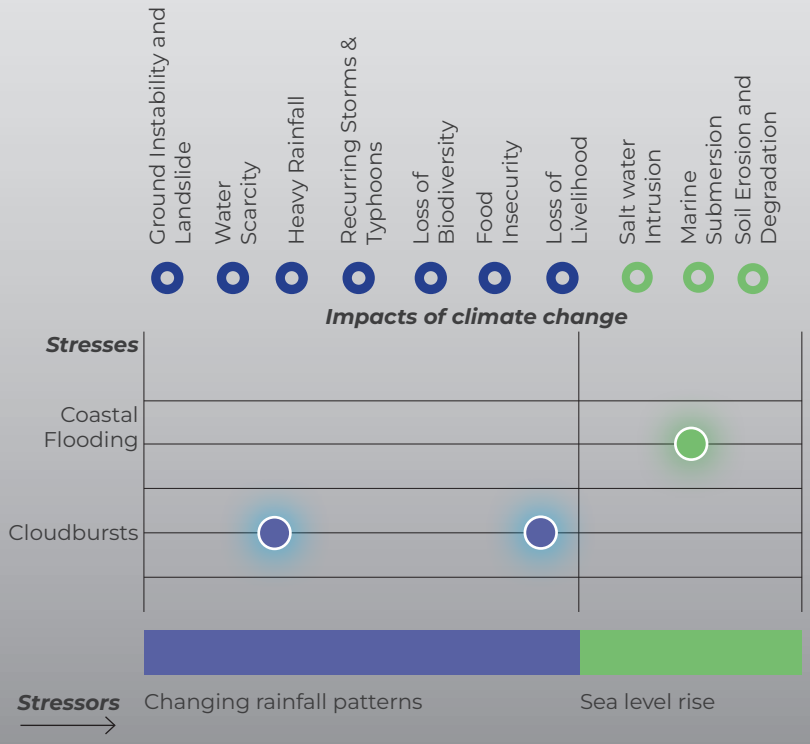
Heritage Profile

Sagar is the largest of the Indian island in the Sunderbans delta in the State of West Bengal. Recurring storms and rising tides have made several smaller islands around Sagar unihabitable by engulfing them. As a result, over the years Sagar has become home to several 'climate refugees' who have migrated here seeking safety. This has put a strain on Sagar's island ecosystem which is itself facing the same challenges from sea level rise as its neighbouring islands. Sabuj Sangha, a non profit organisation based in Nandakumarpur in West Bengal executed the "PARIVARTAN – Holistic Rural Development Project" with support from HDFC Bank on Sagar Island in the South 24 Parganas District of West Bengal. The project's purpose is to address climate change while also creating livelihood opportunities for marginalized people.

Climate Change Profile

Impacts of climate change

- *Sea level rise* - Tidal gushes, ocean flooding, persistent land submersion
- *Salination and acidification of soils* - Constant saline seawater flooding of the island's low-lying coastal regions and potable water sources
- *Changes in water table* - Water shortages are a major danger to the population's ability to support itself through food and other sources



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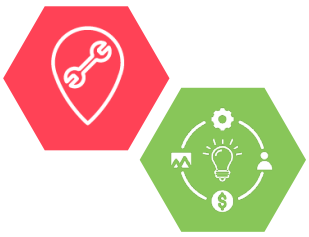


Demonstration projects/ Proving by doing

- One of the focus areas of the Parivartan project is Natural Resource Management which involves the construction of rain water harvesting structures through the renovation of community Ponds. The ponds on this island are the main source of sweet water reserve for agriculture, animals and the island dwellers. To protect the ecological balance of the island, six community ponds were renovated during the year 2022-23. These six community ponds have been constructed in five villages - Radhakrishnapur, Rudranagar, Purusottompur, Dakshin Haradhanpur and Sumatinagar. Involving the locals in the renovation of these ponds helped with income generation as well as skill development as a key outcome.

Innovation and social enterprises

- The project demonstrates innovation through its operations and maintenance setup.
- Setting up of Pond committees comprised of families using the pond water to manage the ponds. A maintenance fee is also collected from member families for the upkeep of the water structure.
- Pond committees also use the community pond's water supply and the land space on the embankment for fruit and vegetable cultivation as well as freshwater pisciculture thereby allowing for additional income generation.
- The pond embankments/ bund structures also protect the pond water from salt water intrusion from the sea in the event of a flood caused by high tide.

Agents of Change

Private Sector	HDFC
NGO	Sabuj Sangha

Funding Source

HDFC

2 Chan Chan Archaeological Zone

Location	Typology	Population	Bio-geographic Zone
Chan Chan, Peru	Site	NA	The Costa

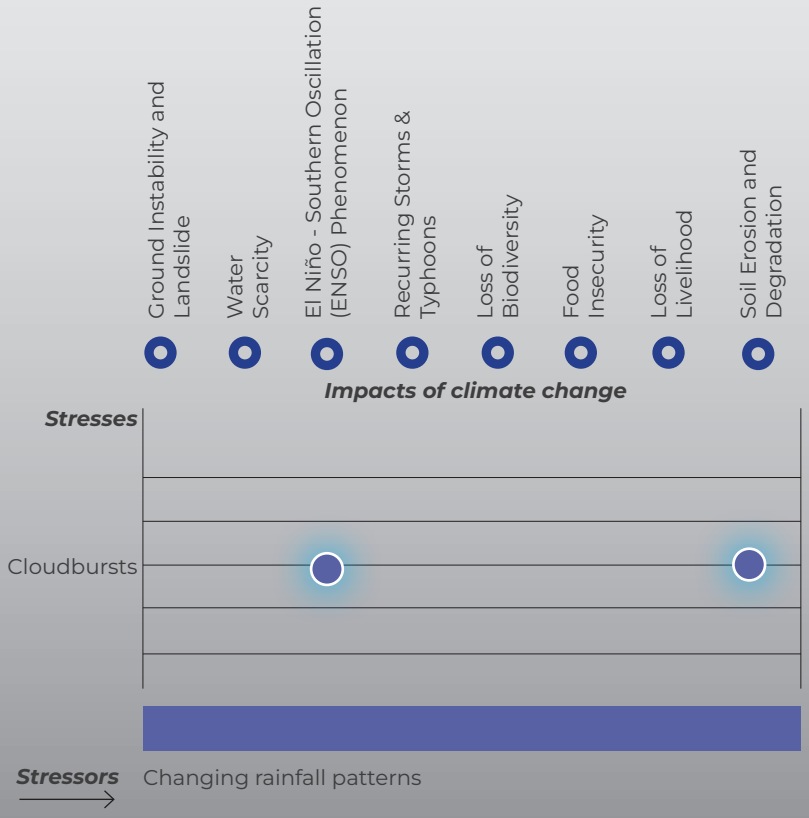
Heritage Profile

Located on the northern coast of present day Peru, Chan Chan, capital of the ancient Chimu Kingdom, is one of the largest and most important prehispanic earthen architecture cities in the Americas. The architectural ensembles and the complexity of the urban design reflect the high political, social, technological, and economic levels attained by the Chimor society. The property was inscribed on the World Heritage List in 1986 under criteria (i) (iii).

Climate Change Profile

Impacts of climate change

- Erosion - Its earthen structures are particularly vulnerable and they require continuous conservation efforts and substantial ancillary measures.
- El Nino-Southern Oscillation(ENSO) - Intense precipitation is damaging the foundations of the earthen architecture structures and, consequently, to an increase in salt contamination of the structures through seepage. Soil erosion and degradation is also prevalent in the low lying huachaques or ceremonial wells evidenced by the growth of vegetation such as reeds and water lilies.



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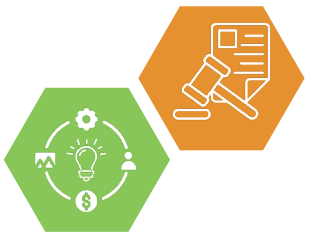


Demonstration projects/ Proving by doing

- The first Management plan was approved in 2000 and updated in 2021 with a ten-year action plan. Implementation of the action plan has mainly involved the maintenance of drains that control the water table level, stabilisation of perimeter walls of palaces and funerary platforms, control of vegetation, maintenance of public use areas, architectural documentation for conservation and management, capacity building for local craftsmen and awareness building measures such as setting up information panels for students and the local community.

Innovation and social enterprises

- Installation of 4270 sq.m roof to protect the archaeological site; innovative adaptation of foundations and structures for the main buildings; the architecture surrounding the Huachaque of the Tschudi Palace using traditional materials and skills as well as modern engineering techniques was carried out to safeguard the site.
- Involving 400 workers in the adaptation work created awareness among the inhabitants of the surrounding areas.
- The first Pan-American Course on the Conservation and Management of Earthen Architectural and Archaeological Heritage was held in Chan Chan in 1996. It was jointly organised by the Government of Peru, the International Organization for Conservation of Cultural Heritage (ICCROM), the International Centre for Earthen Construction (CRATerre-ENSAG) and the Getty Conservation Institute (GCI).
- After El Niño of 2017, founded by the UNESCO Heritage Emergency Fund, UNESCO Lima coordinated a joint UN-Government Post-Disaster Needs Assessment (PDNA) mission in three departments of the northern coast of Peru. The mission included technical training for culture professionals, engagement with local communities and stakeholders, and consultations with environmentalists, architects and tourism industry representatives to elaborate a recovery strategy for the culture sector in the affected provinces, especially in Chan Chan.

Policy regulations and Statutory measures

- Assigning the Ministry of Culture in Peru as the main agency charged with conserving and defending Chan Chan and protecting the property by national laws and decrees has been most beneficial to take appropriate action against climate change impacts. The ministry collaborates with national, regional, and municipal authorities to implement actions, particularly concerning illegal occupation of the site.
- The continuity in the implementation of actions has improved with the creation in 2006 of the Implementing Unit 110 and the allocation of sustained funding for the implementation of the management plan.

Agents of Change

Government	Government of Peru Ministry of Culture, Peru International Organization for Conservation of Cultural Heritage (ICCROM)
NGO	Getty Conservation Institute (GCI)
Other	International Centre for Earthen Construction (CRATerre-ENSAG)

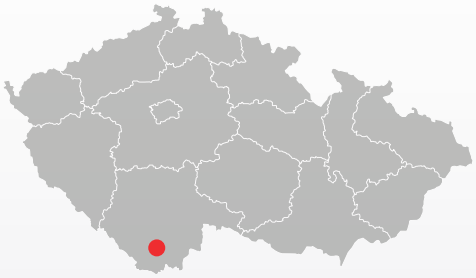
Funding Source

- World Heritage Fund
- Ministry of Culture, Peru

3 Historic Centre of Prague

Location	Typology	Population	Bio-geographic Zone
Prague, Czech Republic	City	13,01,432	Continental

Heritage Profile

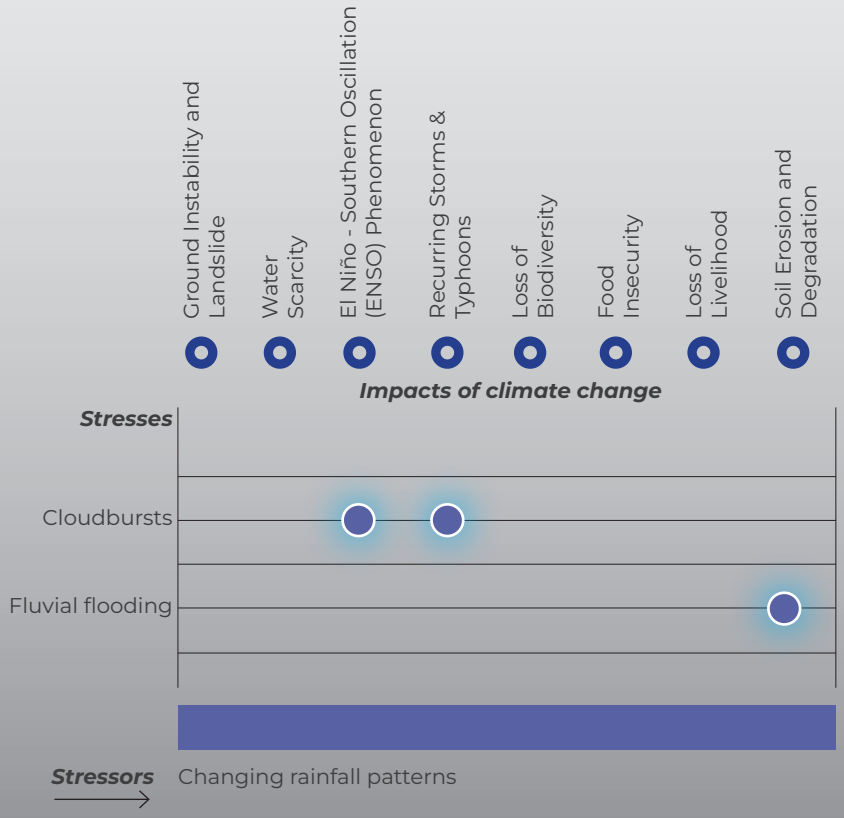


The historic centre of Prague, the capital of the Czech Republic was inscribed on the World Heritage List under cultural criteria in 1992. The Old Town was built between the eleventh and eighteenth centuries; the Lesser Town and the New Town illustrate the great architectural and cultural influence enjoyed by this city since the Middle Ages. Most of its magnificent monuments, such as Hradcani Castle, St Vitus Cathedral, Charles Bridge and numerous churches and palaces were built in the fourteenth century under the Holy Roman Emperor Charles IV. Vltava River, the longest river in the Czech Republic flows through the historical centre of Prague and has been prone to floods in the past. Prague municipality has been developing and implementing a variety of flood control and protection measures, which contribute to adaptation to climate change in this sector. The implemented measures now protect most parts of Prague from flood with a 1 to 500 years return period.

Climate Change Profile

Impacts of climate change

- Extremes in climate variability - Temperature changes, wetter winters, dryer summers and increase in precipitation extremes are some of the changes affecting the city and its population.
- Flooding - The severe flooding event in 2002 was the most expensive weather-related disaster in the history of the city with heavy damage to infrastructure, housing and the environment. 57.5 square kilometres of the city of Prague, which equals to 11.6% of the city area, was marked vulnerable to floods.



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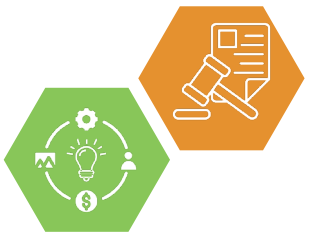


Demonstration projects/ Proving by doing

The construction of the flood control system in Prague was realised throughout 8 phases, each one addressing a specific sector of the Vltava River. The total length of flood protection measures (fixed barriers, solid concrete walls and mobile barriers) after the completion of all stages is approximately 19.255 km, of which 6.925 km are mobile barriers. The specific adaptation measures implemented to control the Vltava river floods include:

- Fixed barriers such as levees, dykes, earth mounds and solid concrete walls have been constructed along the Vltava River.
- Mobile barriers are mainly used in the old historical centre, and partly in the surrounding areas. Mobile barriers are stored in a central storage area and other dispersed locations and are transported and installed as required based on the Flood Management Plan of the City. In Dubeč, a training area for training of mobile barriers installation is built.
- Other measures, such as closures, pumping systems and safety valves are implemented in the canal network along the Vltava River to complement the measures taken along the Vltava River.

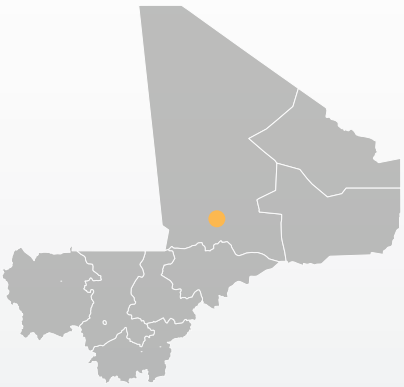
Agents of Change

Government	Ministry of Agriculture Ministry of the Environment Povodí Vltavy Czech Hydrometeorological Institute

4 Timbuktu

Location	Typology	Population	Bio-geographic Zone
Timbuktu, Mali	Site	1,27,328	Arid Saharan

Heritage Profile

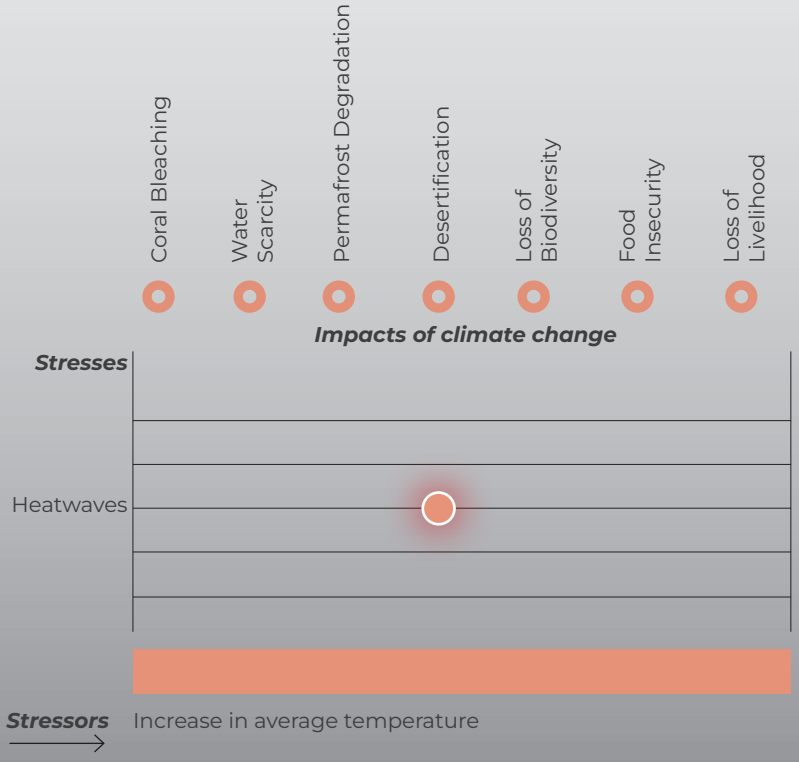


Home of the prestigious Koranic Sankore University and other madrasas, Timbuktu was an intellectual and spiritual capital and a centre for the propagation of Islam throughout Africa in the 15th and 16th centuries. Its three great mosques, Djingareyber, Sankore and Sidi Yahia, recall Timbuktu's golden age. Although continuously restored, these monuments are today under threat from desertification.

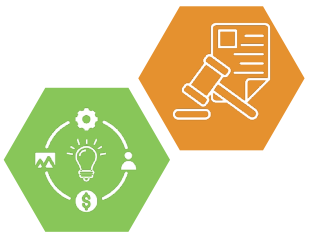
Climate Change Profile

Impacts of climate change

- Desertification - as degradation resulting from various factors, including climatic variations and human activities.
- Desert encroachment - Between 1901 and 1996, temperature increased by 1.4°C in Timbuktu, causing droughts. Future changes suggest decreased rainfall and increased atmospheric temperature, enhancing desert encroachment and sandblown damage.
- Extreme precipitation - Heavy rains in 1999, 2001, and 2003 severely damaged mud mosques in Timbuktu, causing the collapse of traditional earthen buildings and toppling of more recently-built structures.



Nature of Responses



Innovation and social enterprises

- Restoration of the mosques and damaged houses
- Removal of the sand in the vicinity of the mosques
- Creation of buffer zones to protect the mosques from sand encroachment
- Improvement of the drainage systems of rainwater
- Community engagement - These activities were conducted by ensuring collaboration and active participation of all stakeholders (Imams, City of Timbuktu, Cultural Mission of Timbuktu, etc.).
- An important aspect of this project included the involvement of local craftsmen in the restoration process.

Policy regulations and Statutory measures

The site of Timbuktu has three fundamental management tools:

- Revitalization and Safeguarding Plan of the Old Town (2005),
- Strategic Sanitary Plan (2005)
- Conservation and Management Plan (2006-2010)
  Management of the property : Practical functioning modalities, initiated inconsultation with the World Heritage Centre: the Town Planning Regulation and the Conservation Manual.
- Long-term objectives - extension of the buffer zone by approximately 500 m to assure the protection of the inscribed property
- Development of the historic square of Sankore to integrate corrective measures proposed by the Committee at its 33rd session and by the reactive monitoring mission of March 2010 ;
- Extension of the inscribed property to include the entire Timbuktu Medina ;
- Development of an integrated conservation and sustainable and harmonious management project for the site, in the wider framework of development of the urban commune and in close cooperation with the elected members of the Territorial Communities of Timbuktu and the development partners ;
- Active conservation of the mausoleums.

Agents of Change

Government	Management and Conservation Committee of the Old Town of Timbuktu Government of France Government of Mali
Other	UNESCO

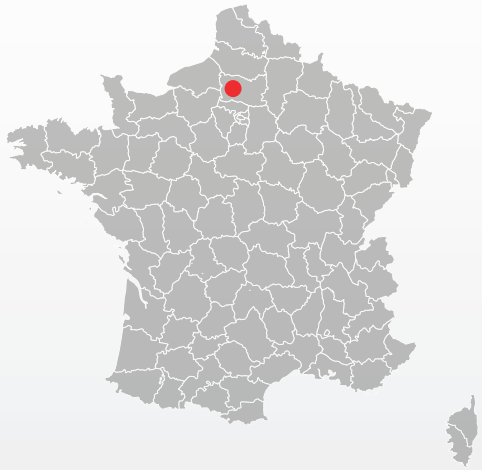
Funding Source

World Bank
The European Union
Switzerland
The U.S. Agency for International Development
Government of Andorra
Government of Bahrain
Government of Croatia
Government of Mauritius

5 WHC Climate Change Adaptation & Mitigation - Paris

Location	Typology	Population	Bio-geographic Zone
Paris, France	City	21,45,906	Atlantic

Heritage Profile

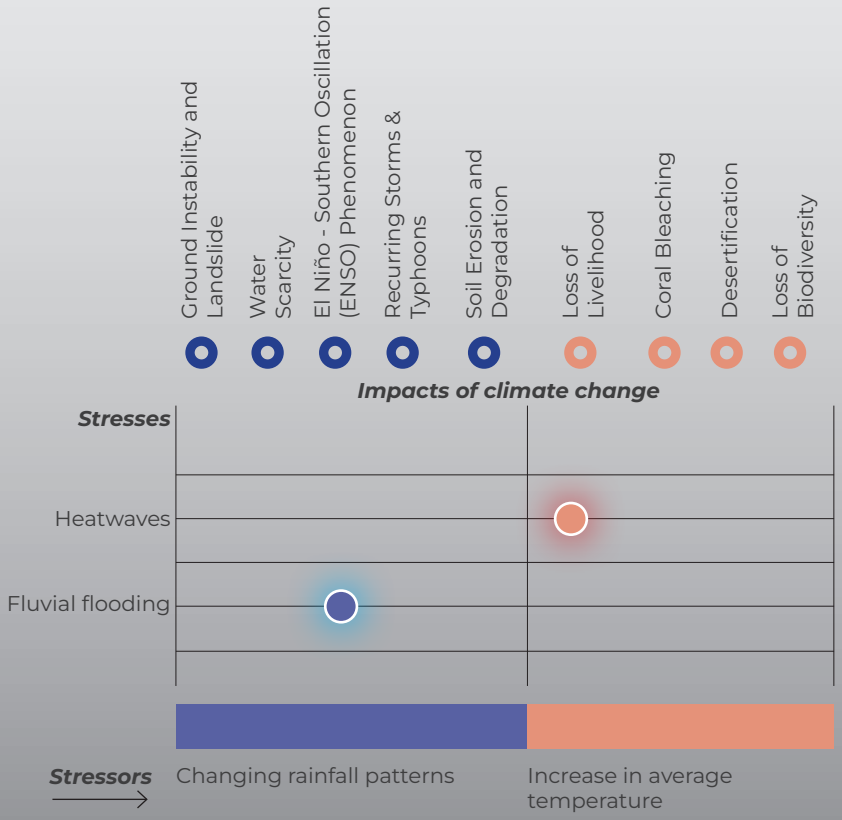


The Greater Paris region, with a population of 12 million, is Europe's largest and most densely populated area. Its service-based economy focuses on finance and information technology, while maintaining manufacturing roles. The Seine River's monuments, including the Louvre and Eiffel Tower, are a World Heritage site. The development of Paris as a whole has been linked to the river and its banks.

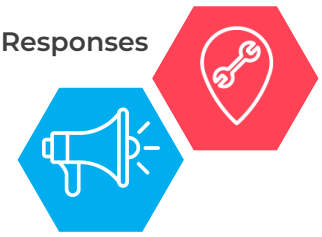
Climate Change Profile

Impacts of climate change

In 2003, Paris experienced a severe heat wave, causing a 127% increase in death rates, affecting vulnerable populations. The city also faces the risk of flooding from the Seine, which could cause 30,00,000 people to be affected, potentially harming electricity and water distribution systems and causing economic disruptions.



Nature of Responses



Information and Advocacy

- Energy audit and renovation of Paris' building stock: Paris's "100,000 buildings plan" aims to renovate all co-owned buildings, focusing on energy-saving measures in common areas through awareness-raising and advocacy within associations.
- Sustainable Tourism: The Paris Climate Protection Plan aims to mitigate tourism's environmental impacts by enhancing inventories, raising awareness, promoting less polluting transport, extending public transport, integrating the plan into city policies, and developing sustainable development measures.
- Heat wave plan: Collaborate with medical professionals and younger volunteers to offer support and services to vulnerable groups during heatwaves.

Demonstration projects/ Proving by doing

- The Paris Climate Protection Plan, published in 2004, aims for a 30% reduction in emissions, 30% reduction in energy consumption in buildings and street lighting, and 30% renewable energy procurement for 2004-2020.
- Energy audit and renovation of Paris' building stock: Paris is implementing a pilot program for three years to improve private buildings' thermal and acoustic efficiency, offering financial assistance and a 20% subsidy in energy audit costs.
- Energy distribution: These measures include air quality and reduction of GHG emissions, optimal management of natural resources, controls over energy demand, and sound energy choices for the future.
- Waste Management: The city of Paris will build a new incineration plant to consolidate heat recovery from waste.
- Transport: The city's new travel plan targets a 60 percent reduction in emissions from innercity traffic by 2020.
- Green Jobs: France aims to create 75,000+ jobs in renewable and wood-energy sectors by 2015, including historic building renovations.
- Adaptive measure: Heat wave plan, Planting trees, Flood risk protection plan, Carbon offsetting

Policy regulations and Statutory measures

- Urban Planning: The city published a sustainable development guide to advise municipalities on environmental and social sustainability measures on every step of carbonneutral urban development, from decision making to the construction process.

6 WHC Climate Change Adaptation & Mitigation - Edinburgh

Location	Typology	Population	Bio-geographic Zone
Edinburgh, Scotland	City	8,19,720	Eastern Lowlands

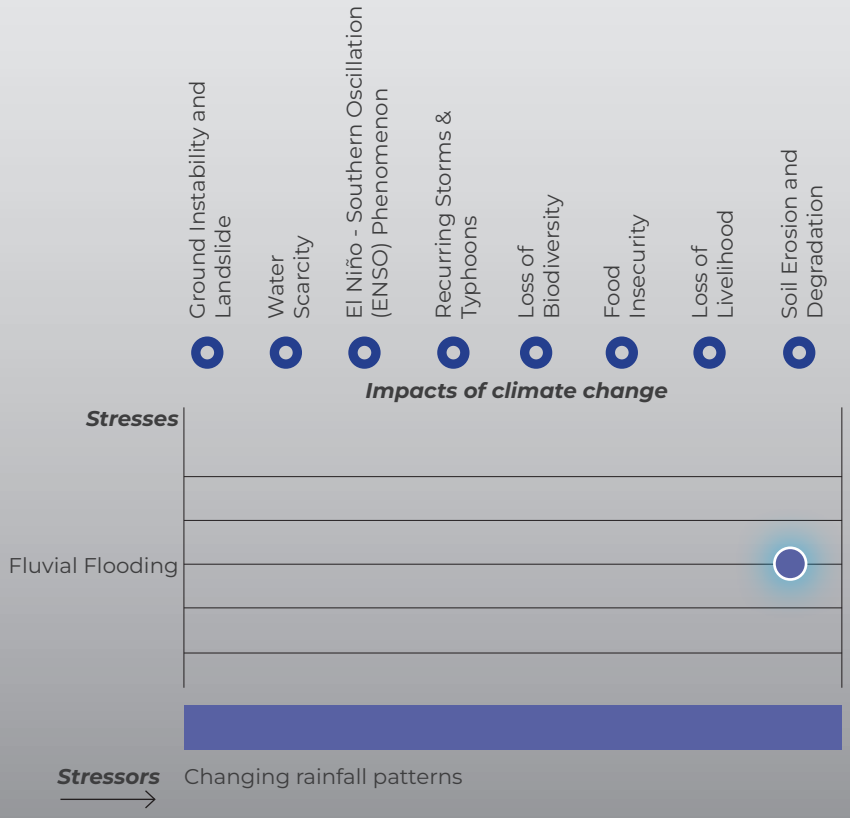
Heritage Profile

Edinburgh is a World Heritage-listed combination of organic medieval and planned neoclassical town systems. The Old Town represents Scottish enlightenment, while the New Town exemplifies its ideals. The Old Town features continuous façades, while the New Town has a hierarchical street network. Edinburgh's unique historic status includes a living urban environment, contributing to economic development and highlighting its role as Scotland's political and economic heart.

Climate Change Profile

Impacts of climate change

The Edinburgh Management Plan acknowledges climate change threats to the World Heritage site, including fire and flood risks. Fires are unpredictable, but flood risk is identified in limited areas. Scotland is expected to experience a 20-30% increase in peak river flows by 2080. Climate change can also affect architectural quality, causing damage to historic buildings and accelerating stone decay.



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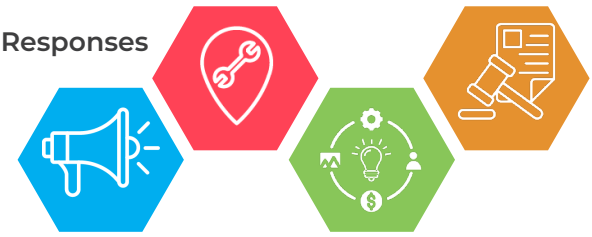


Information and Advocacy

- The “water of Leith” management plan acknowledges river’s role as natural resource and World Heritage, promoting awareness of Leith’s natural, cultural, and historical heritage, and identifying archaeological and cultural features.

Demonstration projects/ Proving by doing

- Edinburgh has developed a comprehensive management plan for the World Heritage site, focusing on climate change and reducing carbon emissions by 26.7 percent by 2050. The plan acknowledges the connection between natural and cultural heritage, highlighting the importance of Edinburgh’s architectural spaces, gardens, and waterways.
- Edinburgh Biodiversity Action Plan aims to conserve Edinburgh’s World Heritage city’s integrity.

Innovation and social enterprises

- “Powering Edinburgh into the 21st century” - Edinburgh should adopt the Decentralized Energy (DE) scenario, focusing on gas-engine combined heat and power (CHP) for emissions reduction. The plan suggests a community heating system to encourage CHP usage, despite potential barriers in historic areas. The operation can be less invasive than establishing pipe utilities or communication networks.

Policy regulations and Statutory measures

- City of Edinburgh Council created an information catalogue to reduce fire risk in Old and New Towns of Historic Scotland, focusing on fire safety management and suppression systems. The council manages a database on historic buildings, highlighting their importance and value.

Agents of Change

Government	The City of Edinburgh Council

7 WHC Climate Change Adaptation & Mitigation - Plan Verde

Location	Typology	Population	Bio-geographic Zone
Mexico City, Mexico	City	88,43,706	Central Volcanic belt

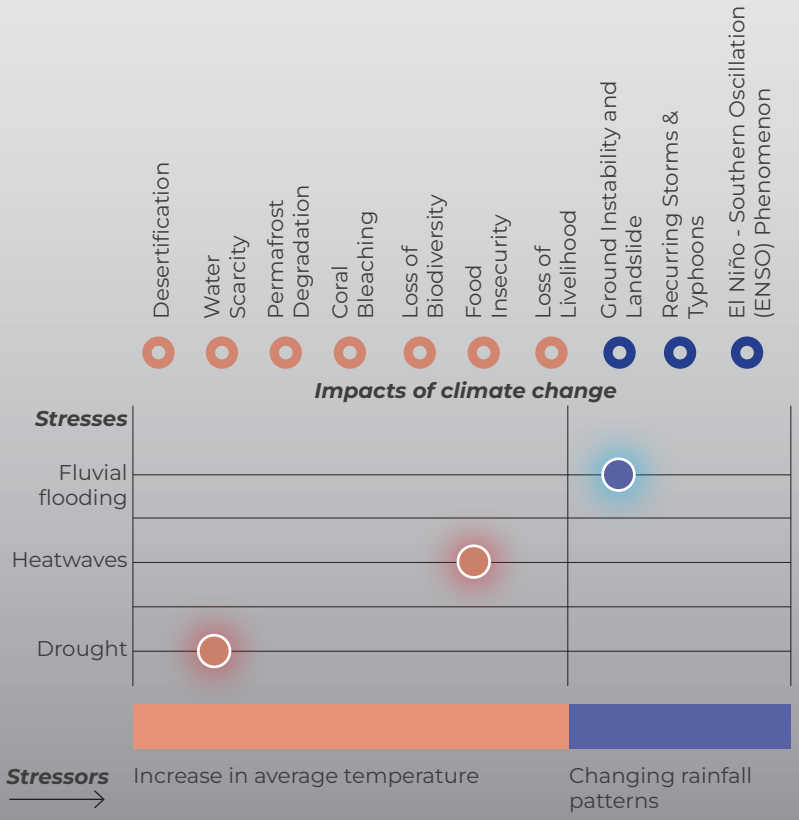
Heritage Profile

Mexico City, a world-renowned historic city, combines Aztec and Spanish cultures. Built in the 16th century, it features a Zocalo, an esplanade surrounded by various styles. Inscribed as a World Heritage in 1987, Mexico City is the largest metropolitan area in Latin America and one of the world, with a population of 21.2 million and 21.8 percent of Mexico's GDP.

Climate Change Profile

Impacts of climate change

- 40% of the city's 4.6 million vulnerable residents reside in high-risk areas, susceptible to landslides, extreme precipitation, and heat waves.
- Mexico Valley faces rising temperatures, causing heat island effects, heat waves, floods, and droughts, with projections predicting a 2-3°C increase by the end of the century.
- Mexico City's high annual precipitation rate, particularly in the western region, increases risks of floods, landslides, and homelessness, while UNESCO warns of seismic instability and aquifer depletion.



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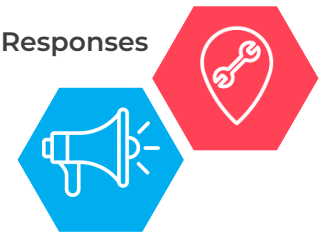


Information and Advocacy

- Plan Verde aims to reduce CO2 emissions by seven million tons and implement an integrated climate change adaptation program by 2012. The expected emissions reductions have been allocated to different sectors: 12% to the water sector, 10% to the energy sector, 35% in the waste sector and 42% in the transportation sector.

Demonstration projects/ Proving by doing

- Energy Sector: Mexico City plans to invest in sustainable multi-family housing, including solar power plants, energy and water saving systems, rainwater collection, waste treatment, and absorption walls. The plan promotes renewable energy sources and encourages energy-efficient lighting in public buildings and transport.
- Water Sector: Mexico City's water action plan focuses on reducing sludge emissions, implementing a home water savings program, improving infrastructure, and improving the sewage system to reduce septic emissions. Additionally, the city has installed low-flow toilets and accessories.
- Transport sector: The plan aims to reduce emissions in the transport sector through 10 actions, including a compulsory school transport system, an additional metro line, and the replacement of taxis with energy-efficient vehicles. Additionally, nine BRT corridors will replace microbuses, and a vehicle inspection program will be established to replace vehicles with energy-efficient cars by 2012.
- Waste Sector: City plans to build gas-fired power plant and compost production plant to capture biogas from landfill, while modernizing recycling system and waste transfer stations.
- Adaptive measures: The plan outlines six adaptation measures; including an early alert system for the Valley of Mexico; a micro-basin management component for urban rivers; assistance for vulnerable groups; remote forest fire detection and monitoring and epidemiological monitoring. It also aims to protect and recover native crops and herbs to maintain agro-system diversity and resilience. The second group of adaptation measures targets medium-term goals in Mexico City's rural zone, focusing on micro-basin management, organic agricultural production, soil recovery, and rooftop greening. These actions address genetically modified foods and promote organic agriculture.

8 WHC Climate Change Adaptation & Mitigation – Hué

Location	Typology	Population	Bio-geographic Zone
Hué, Vietnam	City	3,51,456	North Central Coast

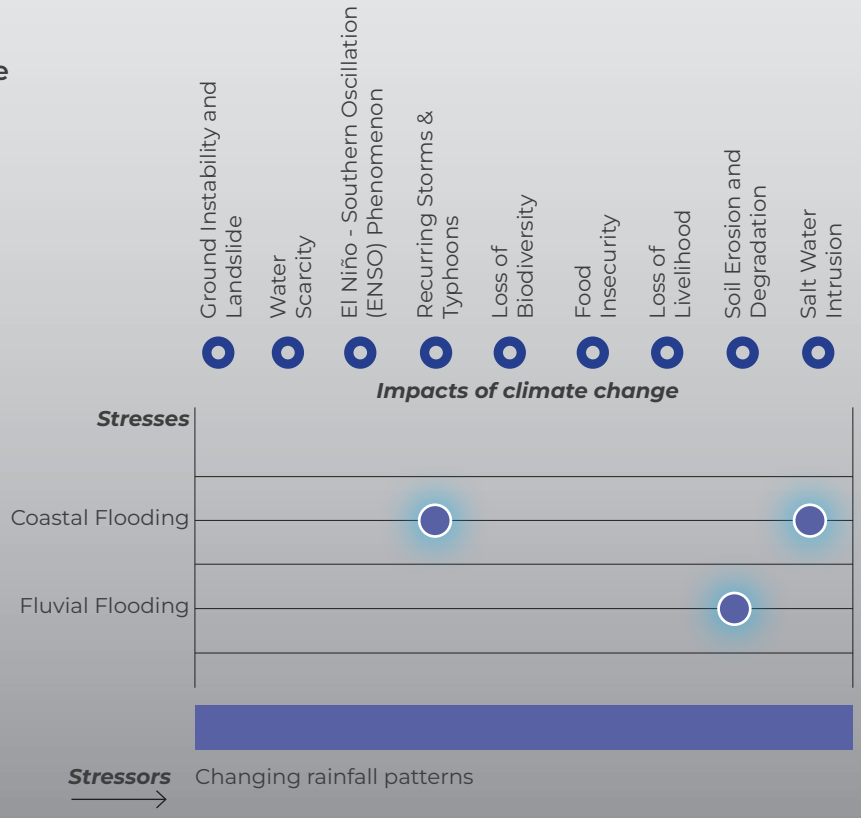
Heritage Profile

Hué, Vietnam's former capital, was recognized as a World Heritage city in 1993. It showcases the art, architecture, and town planning system of the Vietnamese feudal empire. Hué's urban ensemble, consisting of Capital City, Imperial City, Forbidden City, Inner City, and Coastal Bastion, is designed symmetrically on a north-south axis to protect the imperial dynasty from land and sea attacks. The city's architecture features brick, wood, and colorful tiles, adding to its beauty and mysticism.

Climate Change Profile

Impacts of climate change

- Hué is one of the most disaster prone cities in Vietnam and is ranked first among World Heritage Cities on the Mutli-hazard Risk Index.
- Hué faces severe climate change, causing short, rainy seasons, high rainfall, floods, and natural disasters. High annual rainfall leads to soil erosion, affecting fish availability and livelihoods.
- Hué faces droughts, insufficient water resources, and sea-level rise, causing 28.8% tourism revenue loss and 10% GDP loss. Climate change, rainfall, and sea level rise threaten tourism.



Nature of Responses

Demonstration projects/ Proving by doing

- The plan focuses on adaptation actions in water resources, agriculture, forestry, fisheries, coastal zones, energy and transport, and human health. It addresses urban environment activities, such as building reservoirs, upgrading dykes, and conducting long-term water resource predictions. The coastal zone management sector suggests protection measures and relocating settlements and infrastructure. The energy sector emphasizes rational and efficient energy use.

Policy regulations and Statutory measures

- Vietnam's development plans incorporate environmental concerns and GHG mitigation strategies, focusing on renewable energy and sustainable use of existing resources. Urban mitigation measures include improving lighting efficiency in households, commercial facilities, and public areas, and achieving methane recovery from large landfills. These plans are still in the process of development and serve as guidelines.

Agents of Change

Government	Government of Vietnam

9 Traditional Wooden Building Techniques of Japan

Location	Typology	Population	Bio-geographic Zone
Japan	Intangible	NA	NA

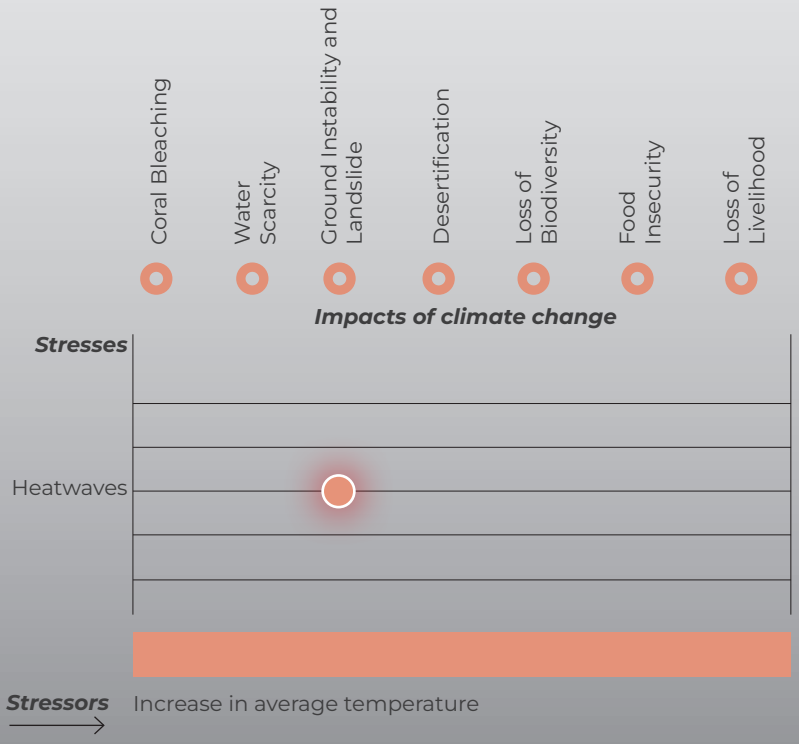
Heritage Profile

In the early modern era, Western European technologies flooded Japan, causing a collision between traditional wooden building techniques and modern techniques. Scientific attempts to understand and apply these knowledge to earthquake-resistant structures were triggered by earthquakes.

Climate Change Profile

Impacts of climate change

Japan's rising temperature and heat island contribute to climate change, altering mold growth and insect life cycles. The region is vulnerable to sea level rise, flooding, and liquefaction during earthquakes. Reclamation has raised the risk of liquefaction during earthquakes, which cause structural damage and fires. Earthquakes can also lead to the rupture of gas pipelines and collapse of electricity pylons, and increased fires from lightning strikes in a future Japan.



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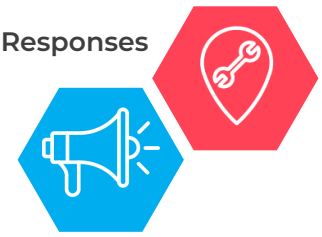


Information and Advocacy

- Earthquake resistance of the traditional Japanese wooden structures is well researched and discussed by Ryo Tanahatashi at the 1960 Second World Conference on Earthquake Engineering. The high seismic resistance is attributed to factors like high damping capacity, longer natural periods, and large potential energy due to horizontal resistance and deformation capacity.

Demonstration projects/ Proving by doing

- Seismic rooms at Palace's: In 1915, architect Yoshikuni Okuma introduced seismic rooms, built before the modern era. These rooms were designed with earthfast pillars, beams connected underground, and shingle roofs to reduce weight and lower gravity during earthquakes.
- Resistance for Temples and shrines: In 1930, Kenzaburo Majima's book "Earthquake and building construction" explained earthquake resistance in traditional wooden buildings. He suggested using inclination of columns for thick columns, installing steel caps and shoes, and avoiding bracings or shear walls at the lowest level.
- Experiments on Horyuji temple: Shizuo Ban experimented with earthquake resistance in the Kondo of Horyuji temple from the 1930s to 1940s. He studied columns, bracket complexes, and frame structures to determine the impact of deformation on thick columns. He concluded that the Kondo's long natural period and high damping prevented collapse, ensuring the temple's wall paintings remained intact.

10 Denso Hall Rahguzar (Walking Street) Eco Enclave

Location	Typology	Population	Bio-geographic Zone
Karachi, Pakistan	Site	1,48,84,402	Coasts

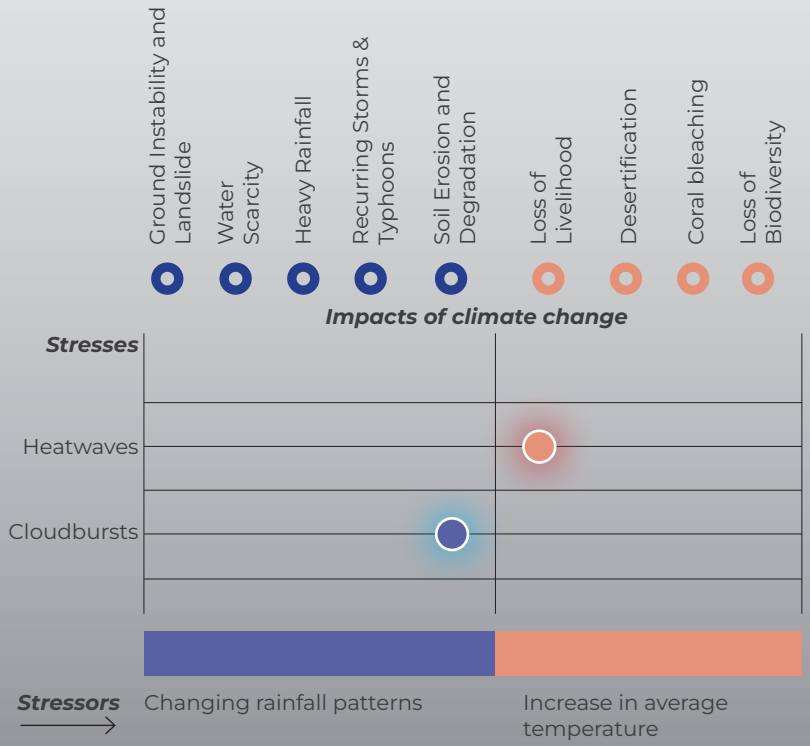
Heritage Profile

The 19th-century Denso Hall building and its surrounding area are have been under conservation ever since 2010, in collaboration with Karachi Electric Supply Company and the city government. The terracotta tiles appear along Rahguzar Walking Street, an "eco-enclave", which sits close to Denso Hall library in Karachi's old town. Architect Yasmeen Lari and Heritage Foundation of Pakistan have worked with disadvantaged communities to craft terracotta tiling for a pedestrianised street in the historic heart of Karachi calling it a new form of social architecture that benefits disadvantaged people.

Climate Change Profile

Impacts of climate change

Karachi, Pakistan's port city, is facing threats from rising sea levels due to climate change. The International Monetary Fund predicts a one-meter rise in global sea levels by 2100, displacing 630 million people in coastal areas. Rising sea levels also cause soil erosion, flooding, degradation of mangrove forests, and impacting fish and plant colonies. Karachi, Pakistan's most vulnerable city, experiences extreme heat, with high mortality rates. In 2015, thousands were hospitalized and hundreds lost their lives in a single day due to heat waves.



Nature of Responses

Demonstration projects/ Proving by doing

- Greenhouse gas reduction and climate adaptation through women-led sustainable development using tangible and intangible heritage.
- Techniques to reduce GHGs and promote conservation of heritage:
- 1,50,000 terracotta cobbles have been installed, reducing flooding through porous paving while promoting an appreciation of hand-crafted items as opposed to machine made concrete materials and serving as a source of livelihoods that has spawned other low carbon terracotta and glazed tile creative industries.
- Over 600 trees have been planted, helping to reduce pollution, promote biodiversity (butterflies, birds, beehives) and prevention of urban heat island.
- Use and reuse of existing urban landscapes, reducing vehicular traffic, and avoiding new cement and steel in favour of zero carbon lime, earth and bamboo.
- Participatory measures: Unemployed people, mostly women - trained at the nearby Historical Monuments at Makli, Thatta World Heritage Property in the ancient craft of fabricating low- carbon terracotta cobbles for pavements.

Agents of Change

NGO	Heritage Foundation of Pakistan
Other	Architect Yasmeen Lari

11 Ark for Iraq

Location	Typology	Population	Bio-geographic Zone
Iraq	Intangible	3,81,24,182	NA

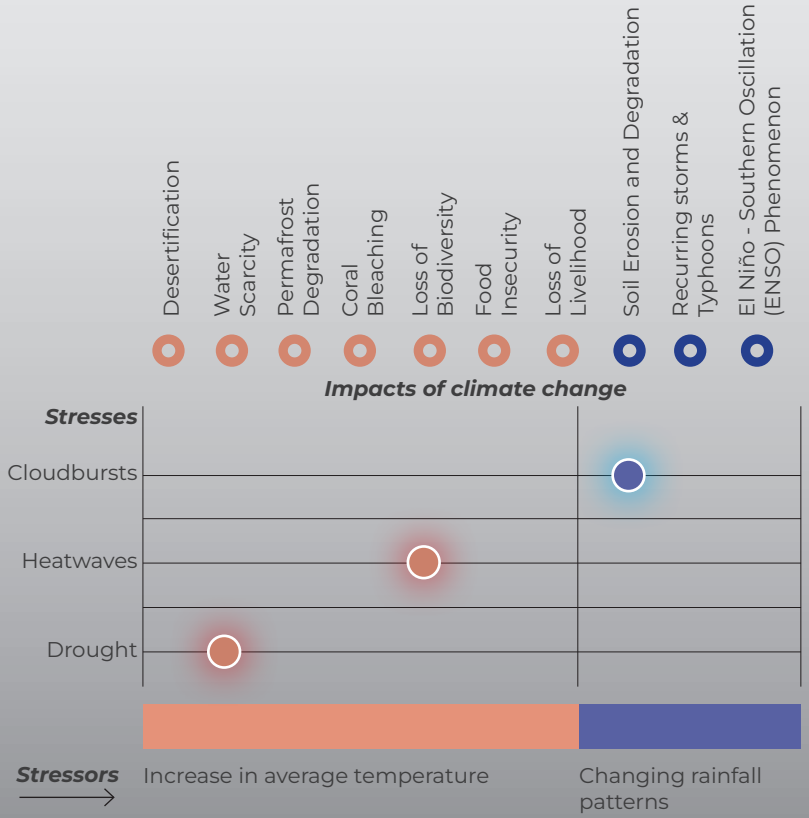
Heritage Profile

Iraq's unique watercraft heritage, dating back to the Sumerians and Mesopotamians, was widespread until the 20th century. However, due to conflict, economic pressures, and environmental damage, these ancient boat types are now endangered. Since 2016, efforts have been made to document craft techniques, transfer knowledge, and revive traditional boats for new uses. This year-long project will work to revitalise and document the endangered watercraft heritage of traditional boats in central and southern Iraq.

Climate Change Profile

Impacts of climate change

Known as the location of the ancient Flood, Iraq now faces a different crisis, through conflict, climate change and water resource shortages. Decades of conflict and trauma, including the displacement of communities and the degradation of the Marshes and other ecosystems, has brought these distinctive and ancient crafts to the brink of extinction



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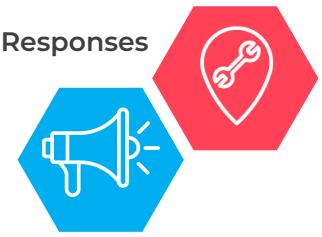


Information and Advocacy

- Safina Projects aims to address Iraq's crisis through an Ark-based gathering, focusing on re-connecting the Iraqi diaspora community, preserving cultural heritage, and addressing conflict, climate change, and water resource shortages. The project aims to gather remains of Iraqi culture for future generations, preserving the country's rich watercraft and maritime heritage.

Demonstration projects/ Proving by doing

- Boats of the Tigris and Euphrates: Boats, a craft tradition in the Tigris-Euphrates river system, have been around since ancient times. Made from locally harvested materials, they are shaped by their place of origin and are used in various activities. However, decades of conflict and trauma have threatened these ancient crafts. Recovering the art of making traditional boats can preserve Iraqi cultural heritage and promote sustainable tourism, leisure, and sporting uses.
- Documenting and revitalising endangered watercraft: Safina Projects is a project involving boat builders from the region to reconstruct four types of traditional boats. The project uses archival and archaeological sources, oral history interviews, and fieldwork opportunities to fill gaps in knowledge and explore the role of boats in the region's cultural and social life. The boat flotilla will travel down the Euphrates River from Hilla to Basra, reconnecting local people with their heritage and creating a unique fieldwork opportunity for academic specialists. The boat reconstructions, river expedition, and oral histories will be documented through video, audio, photographic, and written records, which will be shared locally and internationally through a virtual museum and digital archive.

Agents of Change

Government	Ministry of Water Resources - Centre for Restoration of Iraq's Marshes and Wetlands (CRIMW) Ministry of Culture - Basra Museum
Other	Safina Projects Natural History Museum of Basra Humat Dijlah / Tigris River Protectors Association
Educational Institute	Basra University

Funding Source

British Council Cultural Protection Fund
Department for Digital, Culture, Media and Sport of the United Kingdom

12 Climate Change Adaptation and Mitigation in Lamu Old Town

Location	Typology	Population	Bio-geographic Zone
Lamu, Kenya	Site	1,43,920	NA

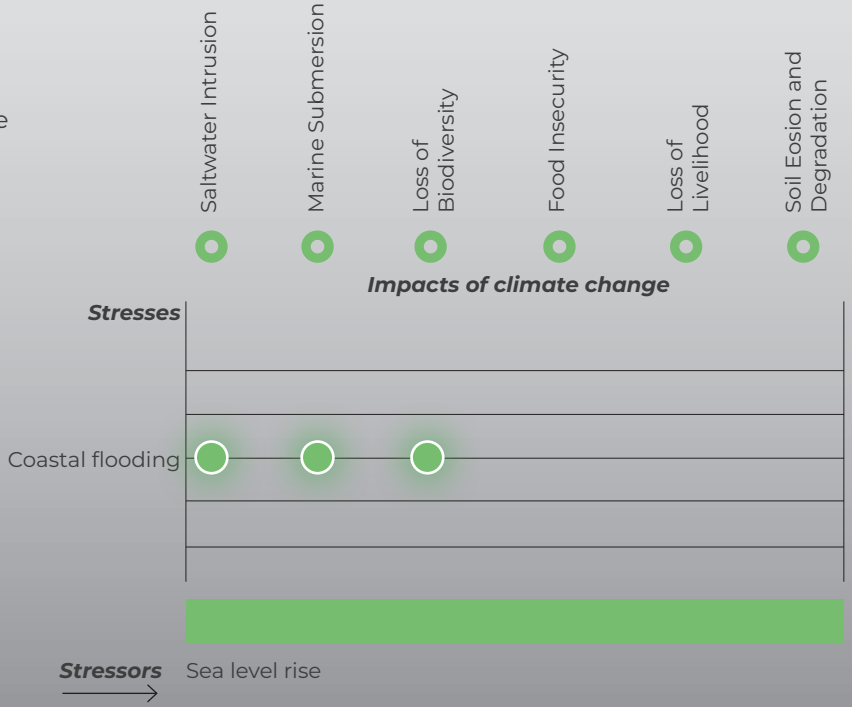
Heritage Profile

Lamu Old Town, the oldest and best-preserved Swahili settlement in East Africa, features simple structural forms with inner courtyards, verandas, and elaborately carved wooden doors. It has hosted major Muslim religious festivals since the 19th century and is a significant center for studying Islamic and Swahili cultures.

Climate Change Profile

Impacts of climate change

- Sea level rise : Lamu Old Town, due to its location on a sandy island, is especially vulnerable to the effects of rising sea levels. Existing vulnerabilities of the electric, waste management and sanitation infrastructure could exacerbate the negative impacts of flooding.
- Inordinate spring tide - causing the periodic flooding of the seafront street with water to knee level length. Buildings affected through capillary action and erosion.
- Destruction of mangroves - which used to serve as a natural defence against strong winds, tsunamis and advancing waves, has exacerbated these risks.



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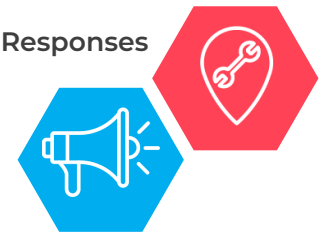


Information and Advocacy

- Climate change adaptation: Monitoring of the periodic flooding of the seafront street: The site manager continues to monitor the volume of water annually.

Demonstration projects/ Proving by doing

Climate change mitigation :

- Plastic waste: Local communities are implementing recycling programs using plastic and discarded metal objects, reducing waste volume and reducing harmful emissions like carbon monoxide. State and non-state institutions support these efforts, while the Municipal Authority invests in mechanical rubbish removal from the Old Town.
- New streetlights: The Lamu Municipality has introduced solar-powered streetlights as a sustainable means for capitalising on renewable energy.

Climate change adaptation :

- Protection of native mangroves: The mangrove forests provide natural protection for the town against advancing waves and possible tsunamis.
- Climate change adaptation: Engaging local communities in documentation and mapping of indigenous knowledge: Traditional knowledge systems help build resilience towards disasters and also provides practical, effective solutions for identification, response, and recovery from the effects of adverse weather.
- In January 2022, the Kenyan National Commission for UNESCO conducted a community empowerment workshop with the support of the UNESCO Participation Programme. Enabling youth to identify and document this body of knowledge ensures its continuity and widespread use by current and future generations.

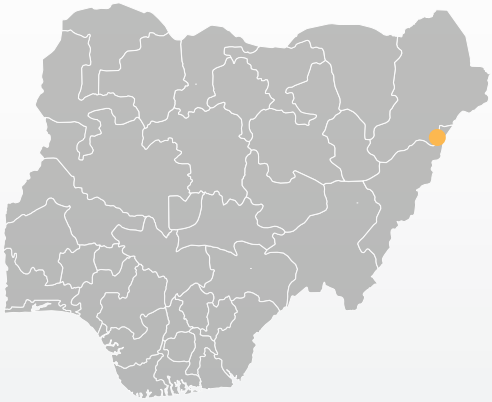
Agents of Change

Government	Lamu municipality

13 Sukur Cultural Landscape

Location	Typology	Population	Bio-geographic Zone
Adamawa, Nigeria	Site	49,02,100	Sudan Savanna

Heritage Profile

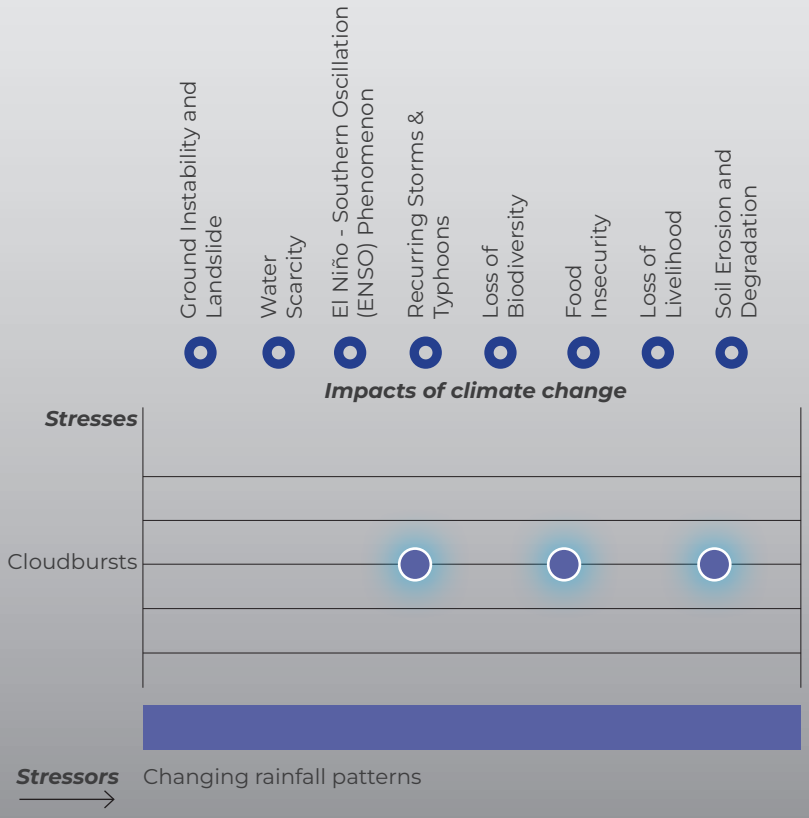


The Sukur Cultural Landscape, located in north-eastern Nigeria, in the Mandara Mountains range, featuring the Hidi Palace, terraced fields, sacred symbols, and a former iron industry, is an intact physical expression of a society's spiritual and material culture. It is affected by climate and environmental change.

Climate Change Profile

Impacts of climate change

- Changing rainfall patterns, wind-storms, and reduced vegetation, affecting agricultural production and traditional building materials availability.
- Decrease in vegetation cover and increased erosion.



Nature of Responses

Information and Advocacy

Climate vulnerability index Workshop :

- CVI assesses climate change impacts on WH properties, considering OUV and community, using a systematic and rapid assessment tool. Workshop results show potential changes in property values and Sukur community's values may not significantly impact the economy, society, or culture over the next 30 years.

Policy regulations and Statutory measures

Recommendations to Nigerian Climate Change Act from the workshop:

- Inclusion of climate change impacts and climate change adaption into heritage management planning
- Continued engagement at state and national level to explore the intersections between local knowledge and adaptation strategies for climate change
- The inclusion of assessments such as CVI into conservation management plans and periodic reporting at heritage sites.

Agents of Change

Government	Sukur Management Committee

14 Traditional Oases Agriculture in M'Zab Valley

Location	Typology	Population	Bio-geographic Zone
M'zab Valley, Algeria	Site	NA	Saharan Desert

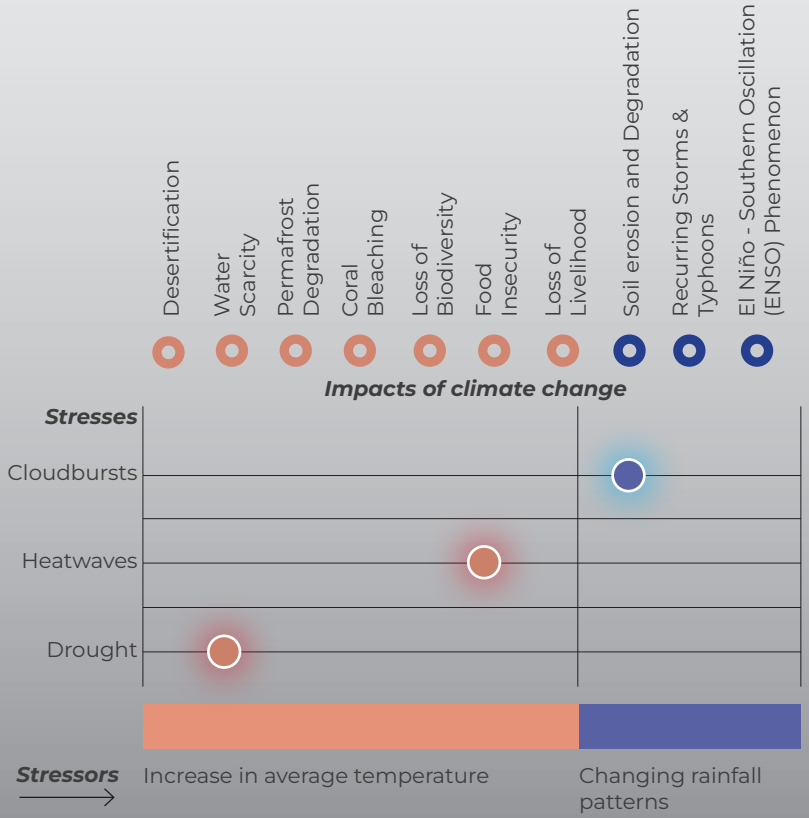
Heritage Profile

The M'Zab valley in the northern part of the Algerian Sahara is recognized as a UNESCO World Heritage site for its urban ensembles in connection with oasis agriculture. In the M'Zab oases in Algeria, communities developed a circular hydraulic system since the 11th century to capture and recharge water from rare flash floods. This system was used for drinking and crop irrigation through shallow wells. The principle of circularity also applied to agriculture and animal husbandry, using by-products, animal traction, and waste recycling, enhancing resource efficiency and reducing environmental waste discharge.

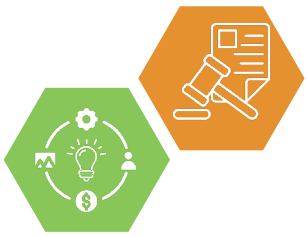
Climate Change Profile

Impacts of climate change

The M'zab Valley is vulnerable to climate change, with periodic overflows becoming increasingly frequent. In the face of climate change, there is a significant need to enhance the risk preparedness of the water distribution system. During the catastrophic floods of 2008, the damages were worsened by improper constructions and a lack of maintenance of water management infrastructure.



Nature of Responses



Information and Advocacy

- On-site workshops trained artisans in historic building maintenance using local materials, collaborating with cultural associations and professional training programs.

Innovation and social enterprises

Traditional water management systems include both tangible and intangible components:

- A community organisation manages the channels and infrastructure that control water flow. Traditional settlements were designed every 25 years to prevent flooding damage, by occupying floodable areas by temporary structures. The abandonment of this practice has led to increased vulnerability to flooding.

The water circularity system:

- Collecting and then diverting the water from rare flash floods to the ancient oases through channels (seguia). Part of the derived water is used to irrigate the date palm gardens on the basis of water rights. These rights are proportional to the number of palm trees of each family.
- The other part of the water is routed to wells, which serve to artificially recharge the water table. These hydraulic structures play a dual function.
- During of the intense and ephemeral flood periods, they allow to recharge of the water table. During the dry period, the water stored in the underground aquifer is then pumped for irrigation.
- Storing floodwater in underground aquifers allows to ensure the availability of groundwater for about 3 years

Policy regulations and Statutory measures

- The Office for the Protection and Promotion of the M'Zab Valley, under Ministry of Culture supervision, promotes heritage conservation, awareness-raising, education, and community involvement in its preservation and management.
- The Office provides free online technical guides and educational materials in French and Arabic to promote cultural heritage values and assist residents in building maintenance and restoration.
- The educational materials produced include:
- Guides to façade maintenance and restoration for traditional buildings
- Information material about heritage protection laws and Learning materials for traditional construction techniques such as stone paving and lime plastering;
- Guide to El-Orf, the traditional construction management system in the towns and palm groves in the M'Zab Valley. Brochures on traditional water management systems and wells and Guides for stone and earthen construction and limewashing. Inventories of historic sites and monuments, tangible and intangible heritage

15 The MOVIDA Project

Location	Typology	Population	Bio-geographic Zone
Po river district, Italy	City	NA	Continental

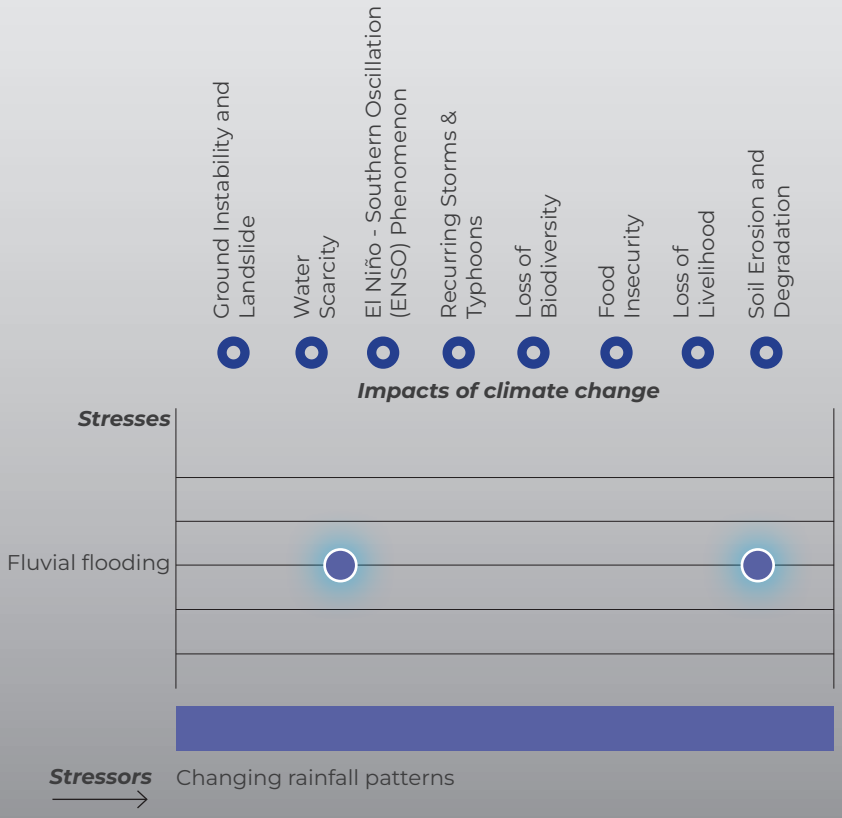
Heritage Profile

EU countries are required to identify and reduce the potential adverse consequences of flooding on human health, the environment, cultural heritage, and economic activity. Flood risk mitigation involves evaluating costs and benefits of intervention alternatives. The European Floods Directive mandates producing risk maps for Flood Risk Management Plans. MOVIDA developed a procedure and IT tools to appraise flood damage in the Po River District, utilizing state-of-the-art damage modeling knowledge. This procedure was applied to areas at significant risk to prioritize mitigation strategies.

Climate Change Profile

Impacts of climate change

The Po River is expected to experience a significant increase in its 100-year flood level by the end of the century, with a projected return period of less than 20 years. However, other rivers on the Italian peninsula also show less significant increases in extreme flood levels. Researchers also project a mean decrease of annual average flood risk by 2030 of around 18%, ranging from 40% to 20%. By 2100, the models become more evenly divided between increases (up to 100%) and decreases (up to 75%), with a majority still predicting a decline. The mean of all projections for 2100 is a 10% decrease in average annual flood risk.



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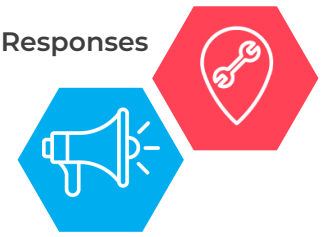


Information and Advocacy

- The objective of the project is to provide an Information System able to perform an analytical evaluation and mapping of expected damage, overcoming the limitations of previous maps where the evaluation of risk remained highly qualitative and subjective.

Demonstration projects/ Proving by doing

- MOVIDA uses appropriate damage assessment tools for exposed elements in the Floods Directive, addressing specific requirements such as validity, reliance on national-level standardized data, and calibration in the Italian context.
- A QGIS plugin called ISYDE supports technicians in implementing tools and visualizing damage results. The tool is transferred to Regional Authorities for flood damage evaluation and mapping in Po District areas at significant risk
- MOVIDA demonstrates the balance between scientific rigor and technical improvement through close collaboration between researchers and practitioners. This led to feasible solutions and the transfer of scientific knowledge. The commitment of multiple research institutions and expertise sharing further enhanced the project. To bridge gaps between academia and technicians, an inclusive/participatory approach in methodology definition and the transfer of methodologies into simple tools without specific expertise can be achieved through GIS technology.
- The MOVIDA project, funded by the Po River District Authority, identifies cultural heritage exposed and vulnerable to floods in Italy's largest river catchment. The project increased the number of cultural heritage structures considered in the plan from 60 to 125,000, classifying objects based on flood hazard, exposure, and vulnerability. A spatial index of impact to cultural heritage was developed.

Agents of Change

Other	Politecnico di Milano, Italian National Research Council,
Educational Institution	University of Bologna, Italy University of L'Aquila, Italy University of Florence, Italy University of Brescia, Italy University of Ferrara, Italy University of Turin - Italy

Funding Source

Po River District Authority

16 George Town, Penang

Location	Typology	Population	Bio-geographic Zone
Penang, Malaysia	City	1,58,336	Sundaland Sub-region

Heritage Profile

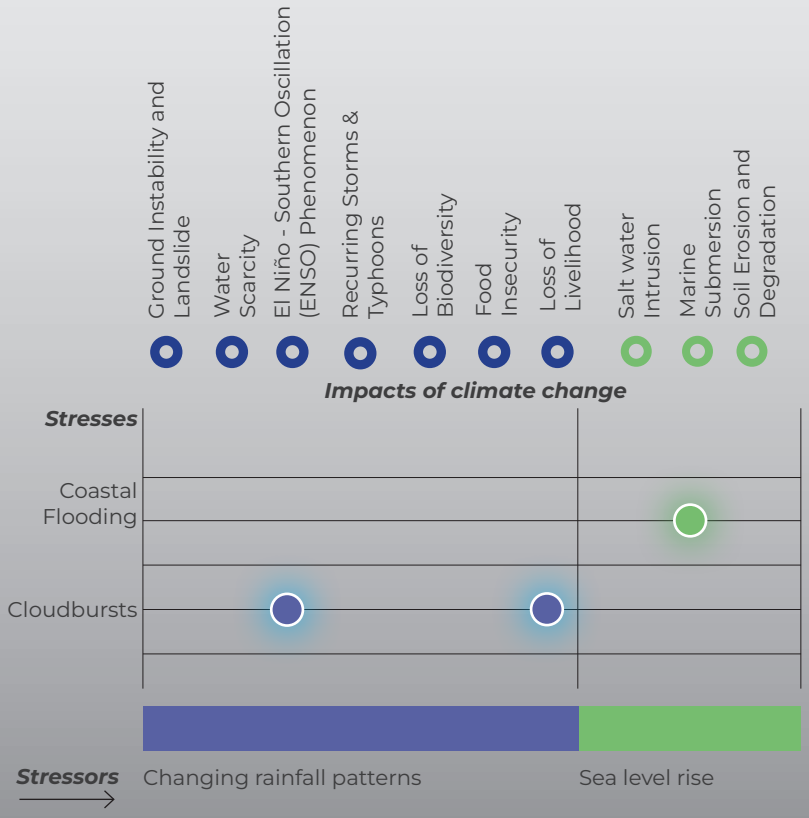
The Historic City of George Town is located in the State of Penang in peninsular Malaysia. It is one of the components of the serial property Melaka and George Town, Historic Cities of the Straits of Malacca, inscribed on the World Heritage List in 2008 under criteria (ii), (iii) and (iv).

Melaka and George Town have developed over 500 years of trading and cultural exchanges between East and West in the Straits of Malacca. The influences of Asia and Europe have endowed the towns with a specific multicultural heritage that is both tangible and intangible. Featuring residential and commercial buildings, George Town represents the British era from the end of the 18th century. The two towns constitute a unique architectural and cultural townscape without parallel anywhere in East and Southeast Asia

Climate Change Profile

Impacts of climate change

- Increased rainfall and changes in rain pattern:
- Economic repercussions of floods are more severely felt by low-income dwellers especially in flood-prone areas.
- Shortage of food supplies, electricity, clean water, banking services and communication problems can affect flood victims.



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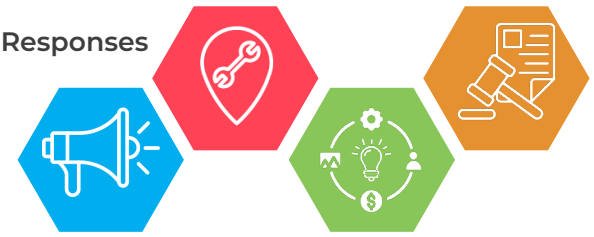


Information and Advocacy

- Public Awareness Campaigns: Public capacity to react calmly during a disaster, AED Training. Posters in 4 different languages to expand the awareness campaign.
- Women and Girls Programme (part of PNBACP) : aims to reduce gender vulnerability asymmetry and strengthen capacity within existing agencies. (Awareness, knowledge, building capacity, empowerment)

Demonstration projects/ Proving by doing

- Backup Copies of Cultural Heritage Inventory List : copies of heritage properties blueprint and inventory list of cultural heritage artefacts
- Emergency Response Team : theory and practical sessions for the community
- Urban Greening (part of PNBCAP) :Tree-lined Streets, Pocket Parks, Greening car parks, Greening built structures, Urban agriculture
- Stormwater Management : Blue-Green Corridors, Swales & Infiltration Wells, Upstream Retention Ponds

Innovation and social enterprises

- Geographic Information System : Map and identify the locations of fore hydrants
- Effective Monitoring with technology : 952 units of cctv cameras - monitor vehicle traffic, flash flood and public safety , 30 flood sesnor devices , colour coded warming and alert system

Policy regulations and Statutory measures

- UNESCO pilot project: Capacity Building for Disaster Risk Reduction of Heritage Cities in Southeast Asia and Small Island Developing States in the Pacific: workshop hosted to identify the efforts, challenges and gaps in the Disaster Risk Reduction Programme , fire and water identified as major hazards .
- Disaster Risk Reduction Management Plan used during 2017 flood
- Disaster Risk Reduction Strategy of George Town : Government and Public Sectors , wide coverage in newspaper and online media - strong branding , 10 action plans developed.
- Nature-Based Climate Adaptation Programme For The Urban Area Of Penang Island (PNBCAP)
- Institutional capacity will be built through a knowledge management platform, the creation of the Penang Climate Board and a public health programme.

Agents of Change

Government	Penang Climate Board (Penang Island City Council) Ministry of Education, Malaysia George Town World Heritage Incorporated
Other	UN Habitat

Funding Source

PNBCAP - Adaptation Fund : Part of KYOTO Protocol

17 Rotterdam

Location	Typology	Population	Bio-geographic Zone
Rotterdam, Netherlands	City	6,64,071	Atlantic

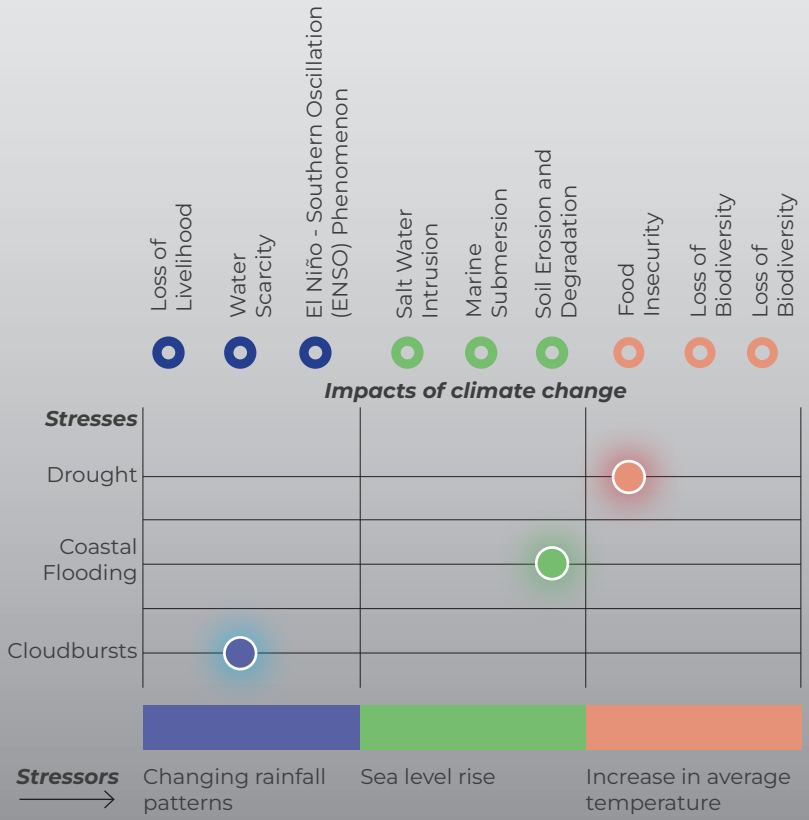
Heritage Profile

Located in the province of South Holland. It is the second largest city by population in the Netherlands after the capital Amsterdam and, together with The Hague , constitutes the 11th urban area by population in the European Union. It has the largest port in Europe , and 11th in the world: the Europoort. Its location in the delta of the Rhine and the Maas, dominated as it is by these great rivers and by the sea in particular, makes the city vulnerable to the effects of climate change. Water plays a central role in the city's adaptation strategy. Rotterdam has a long tradition of continually adapting to new circumstances and anticipating and benefiting from economic and social change.

Climate Change Profile

Impacts of climate change

- Climate projections indicate that the city of Rotterdam will experience sea level rise, heavier rainfall, drought and a changing river runoff.
- Scenario-analysis revealed an increase in flood risk towards the year 2100



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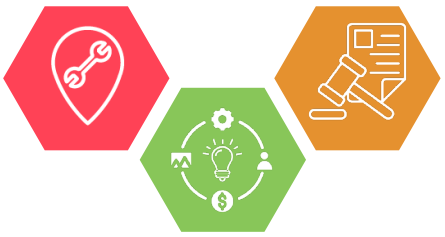


Demonstration projects/ Proving by doing

- Polder roof project proposes the transformation of the roof of the 'Katshoek' parking garage into an attractive green roof that stores and reuses rainwater from the nearby buildings in a controlled way for urban agriculture. It will also become a place for everyday recreation and outdoor events

Innovation and social enterprises

- Combining urban transformation with innovative resiliency measures based on the Rotterdam Adaptation Strategy. The process included a deep analysis of the district climate conditions and a series of workshops where ZoHo citizens and professionals were working together to define specific strategies and a shared perspective.
- ZoHo Rainbarel is a participative water storage system. It is designed by Studio Bas Sala to be an icon for ZOHO and a smart solution for rain water reuse and storage at the same time.
- Water Storage capacity : The 'sponge function' of the city will be restored by taking measures to capture and store rainwater where it falls and to delay drainage. These measures include green roofs and façades, less paving and more vegetation in public streets and neighbourhoods, water squares and infiltration zones as infrastructure.
- Tidal park programme : wetland-related ecosystem services are being restored: water storage, water flow regulation, and water filtration

Policy regulations and Statutory measures

Rotterdam Climate Proof (2008) and the Rotterdam Climate Change Adaptation Strategyxix (2013) :

- Strengthen a robust system of flood, storm water surge and sea-level rise defences
- Adapt the urban space to combine its three functions: 'sponge' (water squares, infiltration zones and green spaces), protection (dykes and coastal protection) and damage control (evacuation routes, water- resistant buildings and floating structures)
- Increase city resilience through integrated planning
- Foster the opportunities that climate change brings, such as strengthening the economy, improving the quality of life, and increasing biodiversity.

Agents of Change

Private sector	De Urbanisten

18 Santo Domingo Tehuantepec

Location	Typology	Population	Bio-geographic Zone
Mexico	City	67,739	Interior Oaxaca

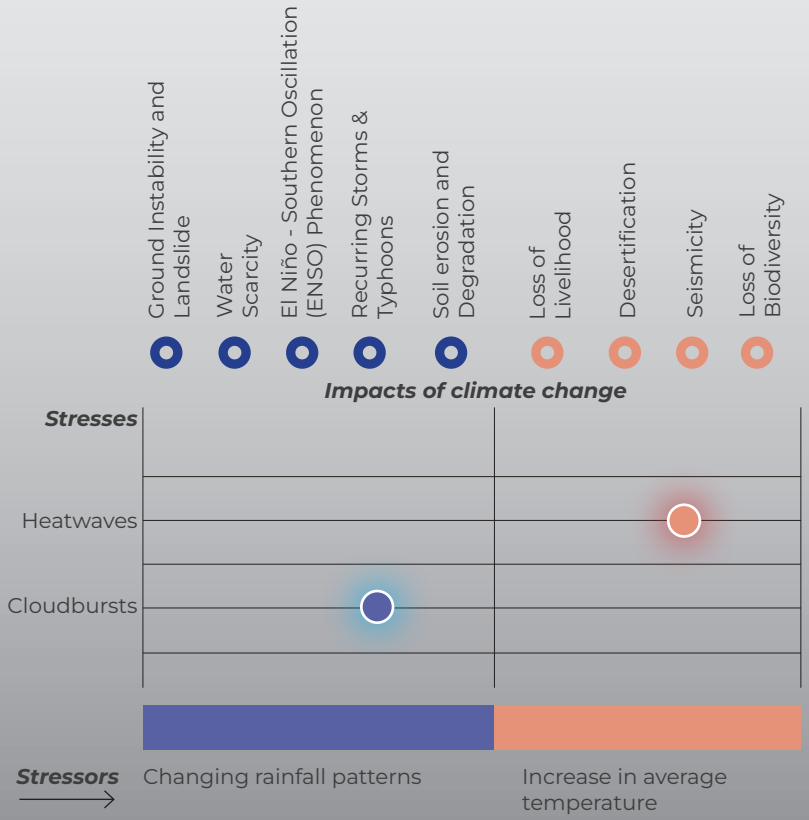
Heritage Profile

Santo Domingo Tehuantepec (Tehuantepec) is a 500-year-old historical city in the south-east of Oaxaca, Mexico,The city has an ular urban layout divided by the Tehuantepec River, developed through a century-old transformation process. There is urban development around the main where many historic buildings are still preserved.

Climate Change Profile

Impacts of climate change

Tehuantepec is located in one of Mexico's highest seismically active regions, with a history of strong earthquakes that damaged the local heritage and the built environment. In 2018, Mexico's Meteorological Service registered 25 cyclones on the Pacific coast, 12 were classified as hurricanes, and 9 were of category III or above (Bravo Lujano, 2019). In the last few years, these events have doubled above the annual average, representing the gradually increasing frequency of cyclones and heavy rainfall, most likely due to climate change (Kelman, 2020).



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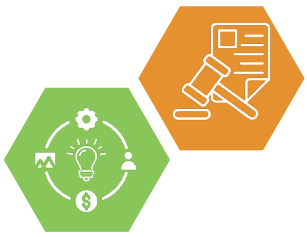


Information and Advocacy

Capacity building and training :
Creation of local first response task force. collaboration between Local authorities and community to designate public squares and evacuation areas.

Innovation and social enterprises

- Risk Mapping and vulnerability assessments - collaboration with local stakeholders. - gathering of local information, threat and vulnerabilities. The data compared with quantitative data from offical sources. -
- Stakeholder map created - institutional, private and community. (experienced architect in local heritage, local chronicler, edlerly community members).
- Use of GIS files, from CENAPRED's Risk Atlas.
- Three day workshop on Participatory mapping of risks for cultural heritage. (Disaster Inagination Game Methodology)

Policy regulations and Statutory measures

- Pilot projectto improve protection of heritage assests in 16th century convent building.
- 2017 - Participatory Disaster Risk Managment Plan(DRM) - primary goal.

Agents of Change

Government	INAH - National Institute of Anthropology and History Built Heritage Office - Local Government
Other	National School of Conservation, Restoration and Museography,Mexico

19 Stepwells, Rajasthan

Location	Typology	Population	Bio-geographic Zone
Rajasthan, India	Site	8,10,32,700	Semi-arid and Desert

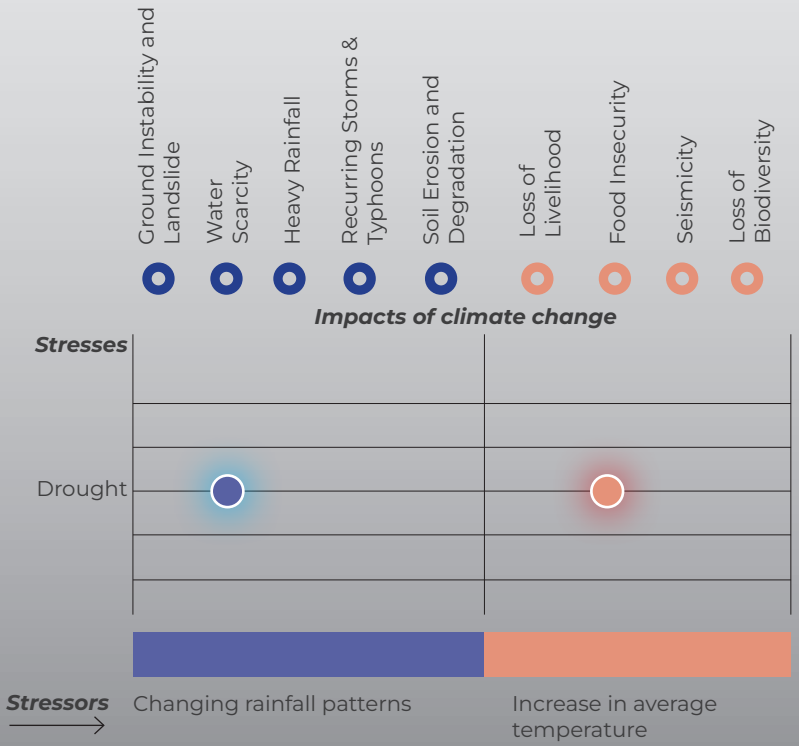
Heritage Profile

The traditional, stone step wells of Rajasthan state in India were used for drinking, washing and bathing as well as during festivals and sacred rituals. A series of earthquakes, wind storms and droughts caused damages so severe that the wells lost their function over the years. Sandstorms and heavy rainfalls further threaten their existence.

Climate Change Profile

Impacts of climate change

The state of Rajasthan has the maximum probability of occurrence of drought in India, with recurring droughts in 3–4 years in a cycle of 5 years and this condition may deteriorate in terms of severity of droughts in Rajasthan. Climate is projected to increase drought occurrence in the state which would impact not only water resources but also have a cascading effect on other dependent sectors. For pastoralists and agro-pastoralists whose livelihoods and food security depend on livestock, drought conditions can cause malnutrition or disease in livestock because of insufficient fodder and deterioration in pastoral lands.



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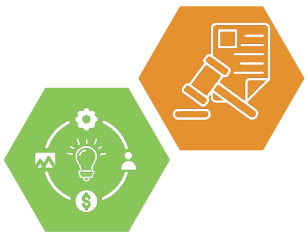


Information and Advocacy

- Successful rehabilitiation of wells encouraged similar projects and raising awarness about traditional water harvesting structures.

Innovation and social enterprises

- Groups of stepwells identified.
- Project Implementation and monitoring committees (PIMC) and Water Users Committee formed.
- Trained self help groups (SHG) who also monitor and report to GBS.

Policy regulations and Statutory measures

- Conducting cultural significance assessment, community impact evaluation and cultural impact assessment alongside other assessments; Integrating effectively and consistently Indigenous/local/traditional knowledge systems in existing adaptation and mitigation processes.

Agents of Change

NGO	Gram Bharati Samiti (GBS)

20 Venice

Location	Typology	Population	Bio-geographic Zone
Venice, Italy	City	8,46,962	Continental

Heritage Profile

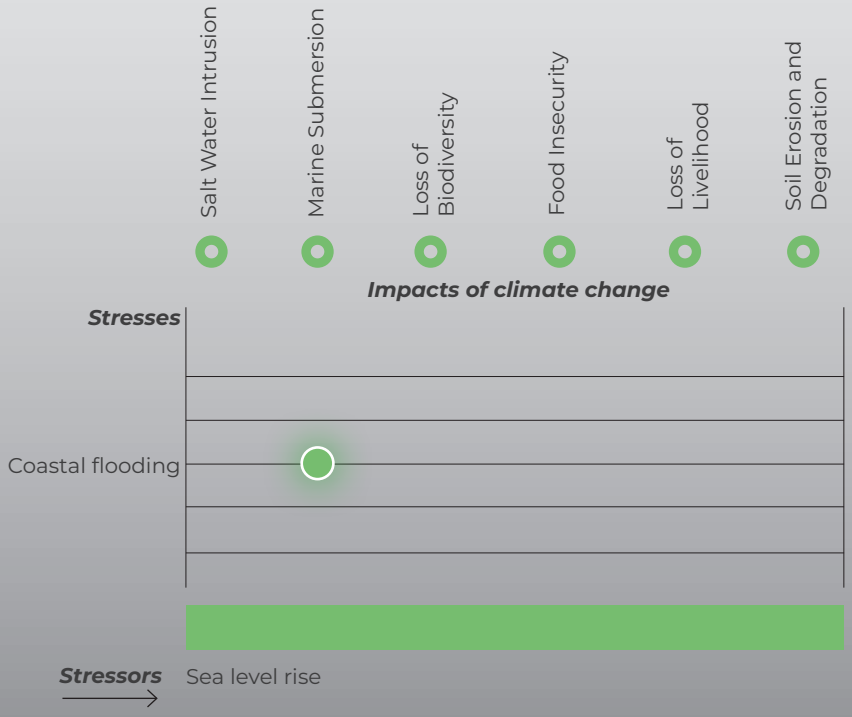
The UNESCO World Heritage property comprises the city of Venice and its lagoon situated in the Veneto Region of Northeast Italy. Founded in the 5th century AD and spread over 118 small islands, Venice became a major maritime power in the 10th century. The whole city is an extraordinary architectural masterpiece in which even the smallest building contains works by some of the world's greatest artists such as Giorgione, Titian, Tintoretto, Veronese and others.

In this lagoon covering 70,176.4 ha, nature and history have been closely linked since the 5th century when Venetian populations, to escape barbarian raids, found refuge on the sandy islands of Torcello, Jesolo and Malamocco.

Climate Change Profile

Impacts of climate change

- A 2021 report published in Natural Hazards and Earth System Sciences suggested that the average sea level could be anywhere from 17cm to 120cm higher in Venice by 2100.
- Venice's unique topography, built on log piles among canals, has made it particularly vulnerable to climate change. Rising sea levels are increasing the frequency of high tides that inundate the 1,600-year-old Italian lagoon city, which is also gradually sinking.



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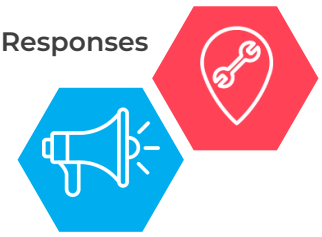


Information and Advocacy

- Promote public debates and awareness initiatives with different stakeholders to raise awareness of the danger of plastic pollution, encouraging the uptake of good practices along with individual and collective actions. (By Venice Lagoon Plasric Free)

Demonstration projects/ Proving by doing

- The dam system MOSE – short for Modulo Sperimentale Elettromeccanico, or Experimental Electromechanical Model.
- A series of retractable barriers have been placed along the entrances to the Venetian lagoon. When high tides and storm surges are forecast, the barriers can be closed, temporarily sealing off the lagoon from the Adriatic Sea.(debated topic)
- Venice Water Authority and Venice Local Authority are raising quaysides and paving in the city in order to protect built-up areas in the lagoon from medium high tides.
- Operate decentralised large scale clean-ups in the city of Venice, its lagoon, including nearby mainland towns and cities.

Agents of Change

Government	Ministry of Infrastructure and Transport - Interregional Authority for Public Works of Veneto, Trentino Alto Adige, Friuli Venezia Giulia.
NGO	Venice Lagoon Plastic Free

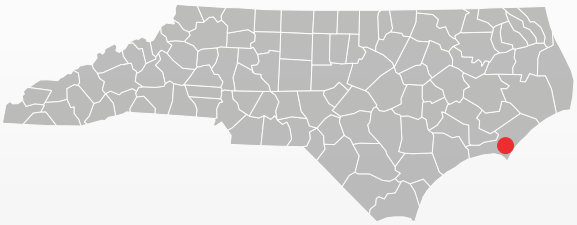
Funding Source

Government of Italy

21 Princeville

Location	Typology	Population	Bio-geographic Zone
North Carolina, USA	Site	1,259	Coastal region

Heritage Profile

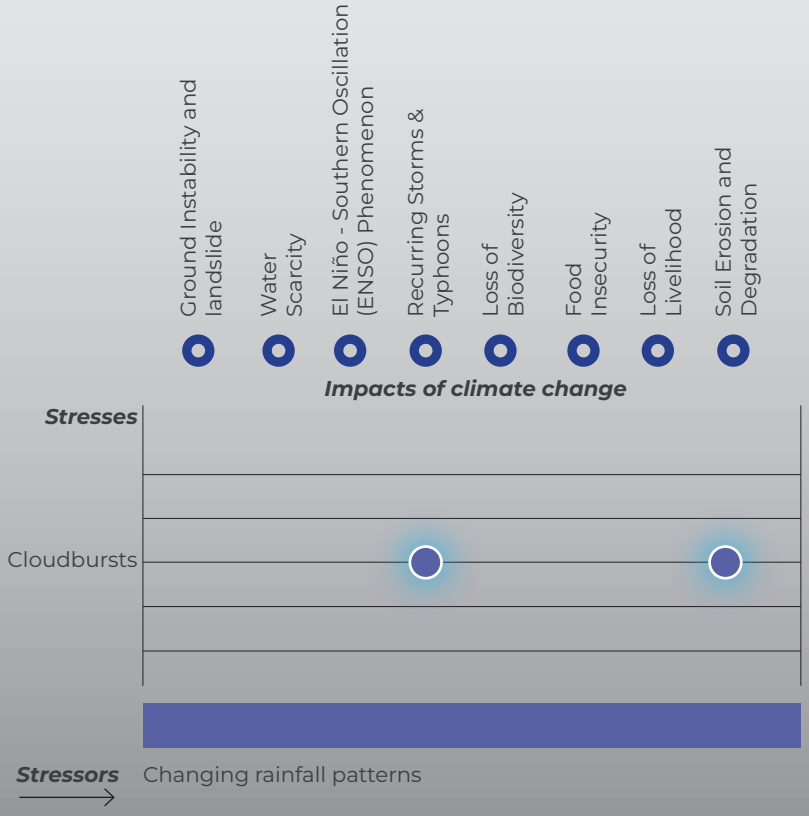


Princeville, North Carolina, is the oldest town in the United States incorporated by African Americans. The town was founded by freed slaves in the swamplands of the Tar River at the end of the Civil War in 1865, in the face of encouragement to return to the plantations where they had been enslaved. Resolute, they chose to remain and build themselves a town, beginning with makeshift shacks and shanties rather than give up their hard-earned freedom. Many residents of Princeville today can trace their ancestry to the town's founders

Climate Change Profile

Impacts of climate change

In the face of climate change, historic communities are becoming more vulnerable to increasingly frequent flood and storm events. The increasing occurrence of extreme events causes repetitive loss and a need for costly rebuilding. Often rebuilding does not address the conditions of future higher water levels in flood events.



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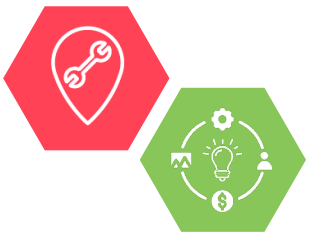


Demonstration projects/ Proving by doing

- Princeville Elementary Water Management Project
- Based on this town-approved blueprint, CTNC began assembling stages of work that could be funded and implemented soon. A National Fish and Wildlife Foundation/ Wells Fargo Resilient Communities grant launched the first phase, focused on where its elementary school and adjacent housing form the town's hub. Hiring local youth, Conservation Corps NC crews created rain gardens around the school and then a nature trail from the school toward the town's history museum. CTNC also provided an AmeriCorps member to support the historical connections between the town's natural and cultural history.
- Justice for Climate Project:
- This project was centered at Heritage Park, where Conservation Corps NC youth built out trails, rain gardens, and plots for benches and exercise equipment. CTNC and our NC State partners are coordinating with the town on implementing this phase of the Floodprint to include trees along the town's main street and additional wetlands and gardens in bought-out properties

Innovation and social enterprises

- Buoyant foundation retrofits of Princeville's important historic and cultural landmarks would provide visually-unobtrusive protection from flood damage, and prevent the forced relocation of this culturally vibrant and historically significant African-American community. After consultation with the community and town officials, the Buoyant Foundation Project has proposed that the Mt. Zion Primitive Baptist Church, several significant historic homes, and the Princeville Heritage Museum be retrofitted with amphibious foundations to prevent future flood damage to the town's important markers of cultural heritage.
- A retrofitted buoyant foundation has three basic components: the buoyancy elements that displace water to cause the building to float above the water's surface, the vertical guidance posts (VGPs) that restrict horizontal movement so that the building can move up and down but not float away, and a new structural subframe installed beneath the existing floor framing system to support and stabilize the building while connecting it to the buoyancy elements and vertical guidance posts

Agents of Change

Government	The Corporation for National and Community Service (Ameri Corps)
Private Sector	Conservation Trust for North Carolina (CTNC)
Others	Conservation Corps North Carolina

Funding Source

Commission for Environmental Cooperation (for the Justice for Climate Project)

22 Ayutthaya City

Location	Typology	Population	Bio-geographic Zone
Ayutthaya City, Thailand	City	20,035	Central city

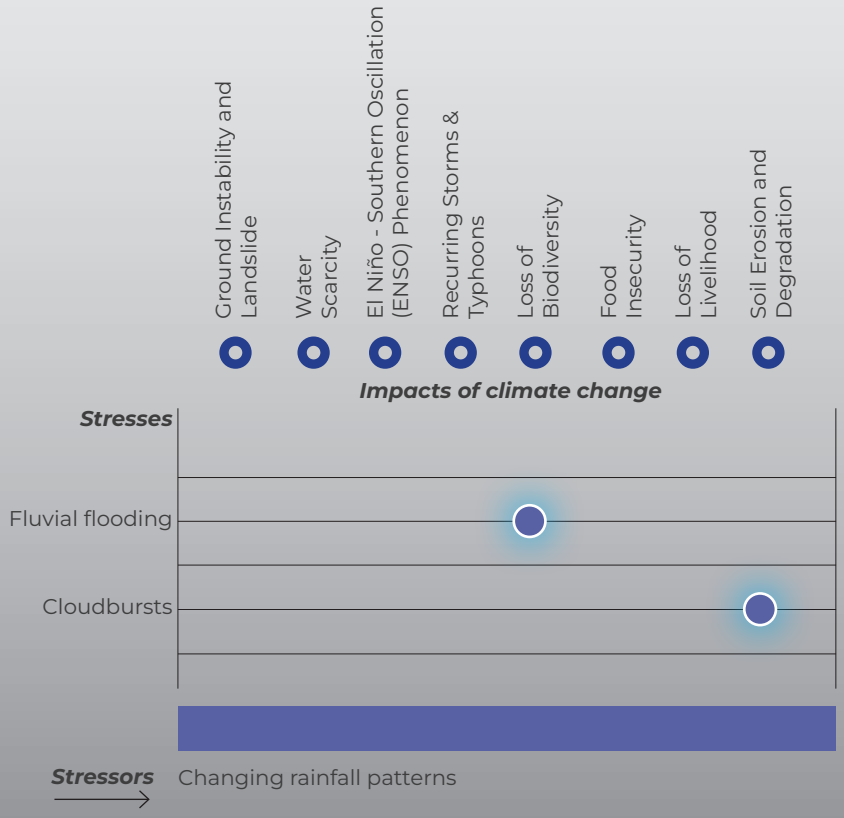
Heritage Profile

Founded c. 1350, Ayutthaya became the second Siamese capital after Sukhothai. It was destroyed by the Burmese in the 18th century. Its remains, characterized by the prang (reliquary towers) and gigantic monasteries, give an idea of its past splendour. The ruins of the old city now form the Ayutthaya Historical Park, an archaeological site that contains palaces, Buddhist temples, monasteries and statues. The park is on an island between 3 rivers.

Climate Change Profile

Impacts of climate change

Climate change is a dominant factor contributing to increase in flood hazards in this area, since tropical storms are expected to increase in frequency and intensity.



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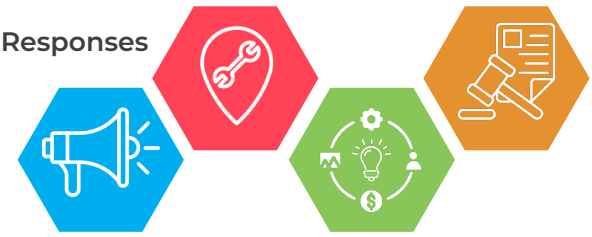


Information and Advocacy

- In Ayutthaya city, the government use the community based participatory. They educate and prepare the people to respond the flood. Water level information help in decision making for flood prevention

Demonstration projects/ Proving by doing

- The agents provided the temporary accommodation, foods, and essential appliances to people.
- The trees or plants are responsible for holding an enormous amount of water when raining.
- Protect and reduce the likelihood of flood by dykes, build water reservoirs
- Restore Forest and Ecosystem

Innovation and social enterprises

- Community became the unit, and people can take care themselves and help other people. water supply continues work and transfer water to community. After flood, local government involved people to clean up their houses and community
- Increase the community and stakeholders to participate in flood management.
- Nature based solutions : The implementation of nature-based solutions involves analyzing land use, terrain elevations, drainage system characteristics, open areas, and local and regional stakeholder preferences. GIS analysis identifies surface areas like flat roofs, parking lots, low-traffic roads, parks, playfields, and transportation corridors as suitable areas for small-scale NBS, such as green roofs and bio-retention.
- The proposal to construct a network of ponds or expand existing ones in the south-west area of the island aims to create a flood detention area that serves multiple purposes, including flood control, recreation, art and cultural activities, rice farms, and floating markets.

Policy regulations and Statutory measures

- Thai government has the master plan for water resources management (NESDB, 2012). This master plan provides the management of water in whole country.

Wat Chai Conservation Project:

- Wat Chaiwatthanaram was deserted, looted, and damaged by floods when World Monuments Fund began conservation work at the site in 2011, in partnership with the Fine Arts Department of Thailand. These efforts include the training and hiring of local technicians and conservators who restore and maintain this iconic structure.

Agents of Change

Government	Ayutthaya City Municipal, Marine Polices Armies, Fine Arts Department US Embassy and Consulate in Thailand

Funding Source

World Monument Fund

23 Dubrovnik iDEAL Project

Location	Typology	Population	Bio-geographic Zone
Dubrovnik, Croatia	City	26,922	Mediterranean

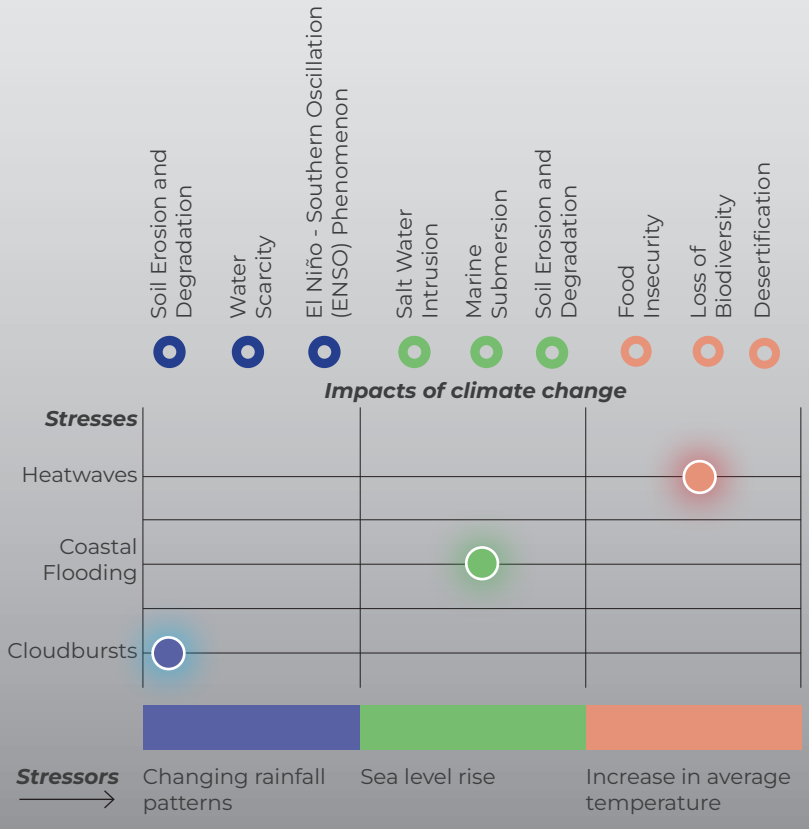
Heritage Profile

Dubrovnik, historically known as Ragusa is a city in southern Dalmatia in Croatia by the Adriatic Sea. It is one of the most prominent tourist destinations in the Mediterranean, a seaport and the centre of the Dubrovnik-Neretva County. In 1979, the city of Dubrovnik was added to the UNESCO list of World Heritage Sites in recognition of its outstanding medieval architecture and fortified old town.

Climate Change Profile

Impacts of climate change

The Republic of Croatia has long been exposed to the adverse effects of climate change which affect ecosystems, economic sectors, human health and cause significant economic losses. According to the International Climate Modeling Results (IPCC, EEA), the Mediterranean basin is designated as a climate "hot spot" with particularly pronounced effects of climate change. There is increasing evidence that the Republic of Croatia is sensitive to climate change and given that it belongs largely to the Mediterranean region, the impact of climate change will increase, and the vulnerability is assessed as high.



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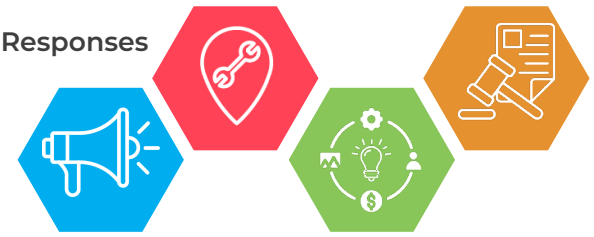


Information and Advocacy

- Use of the Decision Support System (DSS) to enable informed and knowledge-based decisions for the prevention and reduction of the effects of climate change. DSS is an interactive system that analyses and assists the administration in governance processes based on datasheets and indicators. The DSS is intended to introduce elements of rationality in the decisionmaking process, making it transparent, reproducible and allowing stakeholder participation.
- Improving public awareness of climate change and the importance of mitigation and adaptation through information posts in bus stations.

Demonstration projects/ Proving by doing

- The Dubrovnik General Hospital's parking lot measuring 6800 sq.m will be converted into an underground parking space by 2025 and in its place a green oasis for residents, patients, and employees will be created. By replacing the existing asphalt surface with green spaces, the project aims to increase soil permeability and reduce urban heat island effect.
- By 2040, a seawall will be constructed as an adaptation measure with appropriate coastal engineering as a defence against sea level rise and flooding to protect human habitation from tides, waves or tsunamis.
- Installing green roofs, creating green parking lots and increasing green cover using non-invasive tree species like plane tree and magnolia are all planned initiatives to be completed by 2025 to address rising temperatures and provide respite to the citizens while also improving the visual appeal of the city.

Innovation and social enterprises

- Based on the MOSE (MOdulo Sperimentale Elettromeccanico) project in Venice, Dubrovnik plans to build a mobile barrier to prevent flooding caused by rising sea levels at Port Gruž. The mobile barriers are filled with water, which weighs them down and keeps them flat. When a high tidal action is forecast, compressed air is pumped into the barriers, causing them to rotate around the axis of the hinges that they are fastened to and rise to form a wall to stop the tide from entering Port Gruž. Once the threat has passed, the air is released and the barriers are lowered to their resting position.

Policy regulations and Statutory measures

- The Solez project brings together cities which endeavour to implement measures to support low emission zones or other low-carbon mobility policies.It will involve design, development and pilot application of innovative ICT-based services and solutions supporting low emission zones and other access restriction policies, by contributing to reduce the negative side effect of these interventions through participatory strategies with key stakeholders.

Agents of Change

Government	Municipality of Pesaro,Italy Municipality of Misano Adriatico, Italy
Other	IRENA-Istrian Regional ENergy Agency DURA - City of Dubrovnik Development Agency IUAV - University of Venice

Funding Source

Cross Border Cooperation (CBC) Programme Italy-Croatia

24 Post Disaster Assessment, Floods & Landslides, Kerala

Location

Kerala, India

Typology

State, City, All Heritage Assets

Bio-geographic Zone

Coastal, Western Ghats

Heritage Profile

The cultural heritage of Kerala have been categorised in the report as:
1). tangible heritage—monuments and archaeological sites;
2) intangible heritage—traditional crafts, rituals and traditional performing arts;
3). movable heritage—museums and manuscripts in the state.

Climate Change Profile

Impacts of climate change

Floods; Torrential rains triggering several landslides and forced release of excess water from 37 dams across the State, aggravating flood impact .
Kerala's cultural heritage suffered four types of damage and loss:
Monetary loss, Indirect loss of income to the State and the Sector, Socioeconomic ultility loss to tourists, pilgrims and local residents, location-specific tangible and intangible damage and loss.

Nature of Responses

Policy regulations and Statutory measures

- A Post Disaster Needs Assessment (PDNA) Report was prepared. The PDNA methodology was developed in 2008 by EU, World Bank and the UN system, which is a standard methodology to assess damage, loss and recovery needs of any disaster. The PDNA in Kerala was initiated on 18th September 2018 as a complementary tool to the Joint Rapid Damage and Needs Assessment condicuted by World Bank and ADB. The PDNA consists of the following sectors: Social sectors, Productive Sectors, Infrastructure Sectors and Cross-Cutting Sectors. There is a dedicated section on PDNA of 'Cultural Heritage' in the Report. The report also estimates the economic and human impact of the disaster on the cultural heritage sector and provides a recovery strategy to address short, medium, and long term needs.

Agents of Change

NGO	European Union, World Bank (WB), Asian Development Bank (ADB), The UN agencies include, UNDP, UNICEF, UNESCO, UN Women, UNFPA, UNEP, WHO, WFP, ILO and FAO)
Government	Government of Kerala Kerala State Disaster Management Authority

25 3D for Heritage India

Location

Kutch, Gujarat

Typology

Bio-geographic Zone

Desert/ Arid Zone

Heritage Profile

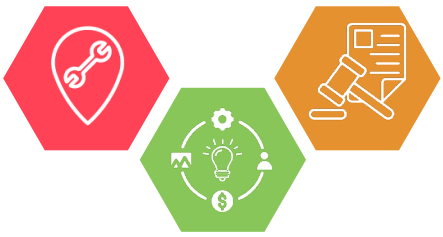
Bela is a village in Rapar taluka in the district of Kutch in the state of Gujarat. The village is located in a desert landscape and is located in close proximity to the India-Pakistan border. Some of the key tangible cultural heritage assets of the settlement are the Darbargadh, residential units and clusters, a market area, religious institutions and sites of memory.

Climate Change Profile

Impacts of climate change

Earthquake is a risk multiplier for climate induced impacts

Climate Action Profile



Nature of Responses

Demonstration projects/ Proving by doing

- Using digital documentation methods as tools for disaster risk management of cultural heritage
- The project is built on the rationale that advanced recording tools can be utilised to break the unsustainable cycle of building replacement after earthquakes towards reuse and risk mitigation
- Though this research project was designed to investigate seismic-prone heritage areas, the use of digital tools for documentation and learnings of the project can be utilised for documentation of heritage sites for the overarching process of disaster risk management of cultural heritage.

Innovation and social enterprises

Using participatory methods in the process of digital documentation of cultural heritage

Policy regulations and Statutory measures

A 'Policy Brief' was prepared under the 3D for Heritage India Research Project. The brief acts as a guidance document for utilising digital documentation tools and techniques to support post-earthquake recovery.

Agents of Change

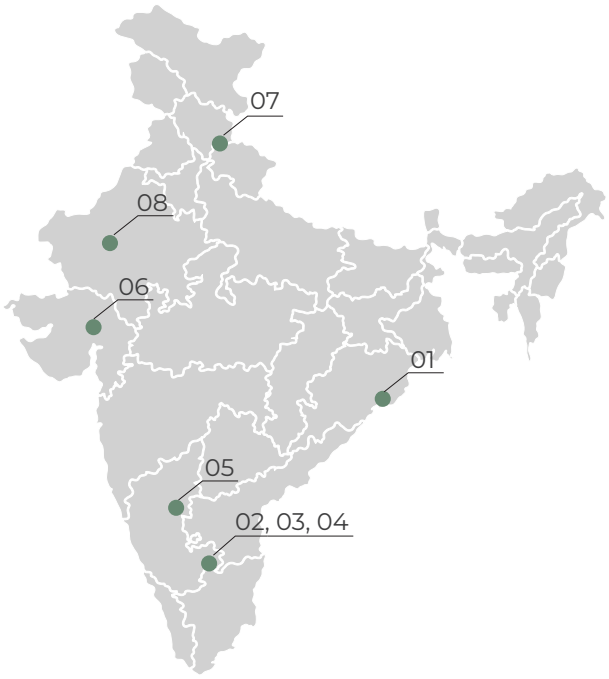
Others	CAUGH, Center for Heritage Conservation
Government	Gujarat Institute of Disaster Management (GIDM)
NGO	ICCROM, Hunnashala Foundation
Educational Institution	Nottingham Trent University (NTU), UK; CEPT Research and Development Foundation (CHC, CRDF)

Funding Source

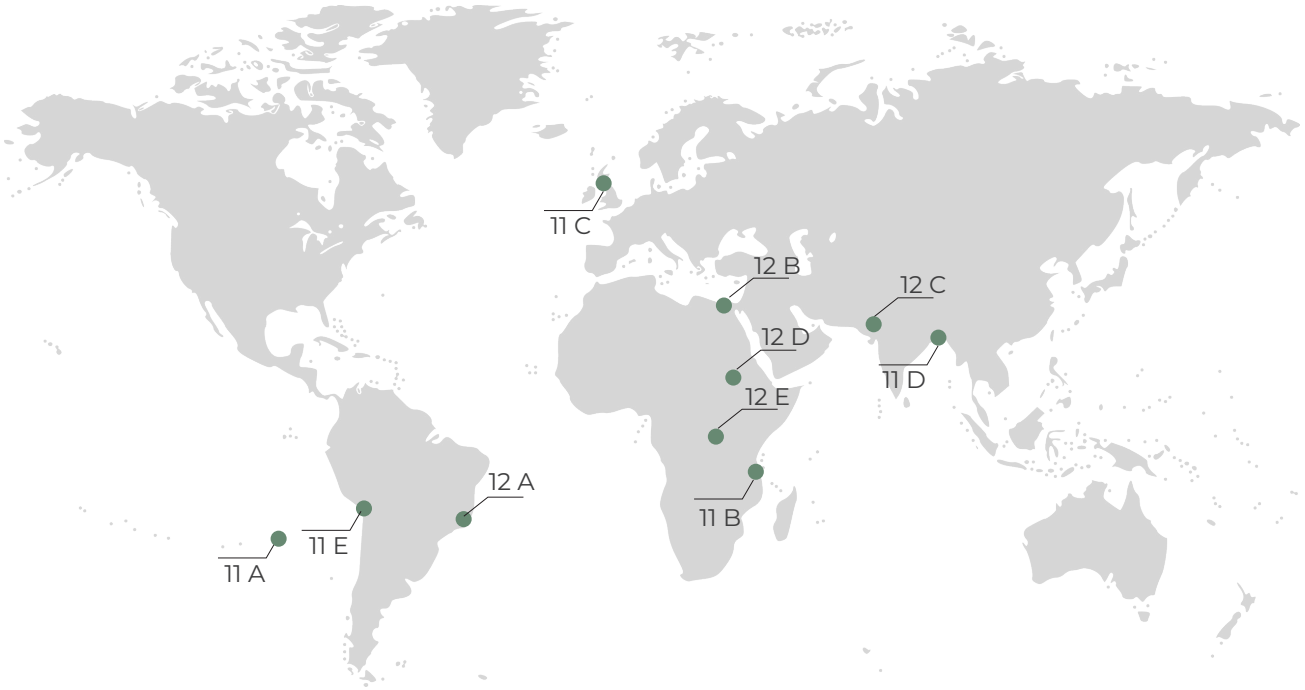
UKRI Arts Humanities Research Council (AHRC)
Department for Digital Culture, Media and Sport (DCMS)

Part C

Studies From Webinar



01 Bhubaneswar, Odisha
02 Bangalore, Karnataka
03 Bangalore, Karnataka
04 Bangalore, Karnataka
05 Hampi, Karnataka
06 Ahmedabad, Gujarat
07 Himalayas, Uttarakhand and Himachal Pradesh
08 Jodhpur, Rajasthan

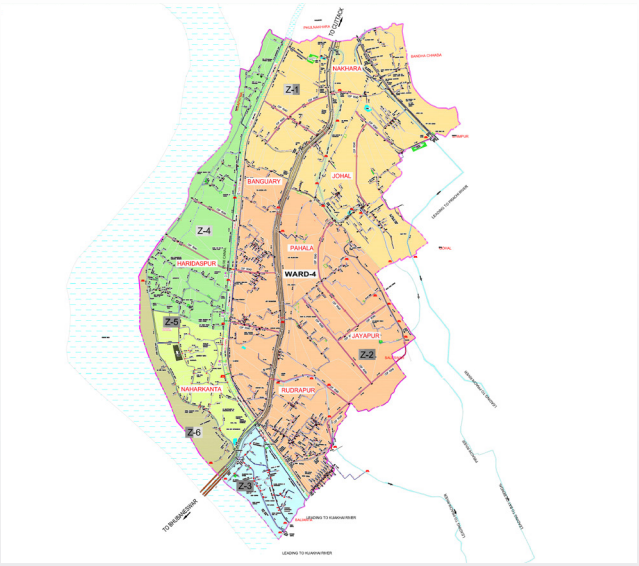


11 A Rapa Nui National Park, Chile
11 B Ruins of Kilwa Kisiwani and Ruins of Songo Mnara, Tanzania
11 C Old and New Towns of Edinburgh, Scotland UK
11 D Historic Mosque City of Bagerhat, Bangladesh
11 E Chan Chan Archaelogical Zone, Peru
12 A Ubatuba, Brazil
12 B Rosetta, Egypt
12 C Jodhpur, India
12 D Tuti Island, Sudan
12 E Kasese, Uganda

All the case studies taken in this section are from the webinar 'Climate Action for Built and Cultural Heritage in Indian Cities' conducted on on August 26th, 2023. Webinar speakers reserve the right to their materials.

1 Integrated Urban Climate Action Low-Carbon and Resilient Cities

Location	Typology	Bio-geographic Zone
Bhubaneswar, India	City	Central Highlands



Drainage Master Plan, Ward no 4, Bhubaneswar
Source- Presented in the webinar by Ms. Vaishali Nandan
Credits- GIZ India, Shared by Ms. Vaishali Nandan

Heritage Profile

Bhubaneswar is the capital city of the Indian state of Odisha. In 2014, 'Ekamra Kshetra - The Temple City, Bhubaneswar' was included in UNESCO's Tentative List of World Heritage Sites by the Indian State Party.

Climate Change Profile

Impacts of climate change

Bhubaneswar is witnessing climate changes in form of increase in the blistering temperature during summer, heavy flood in monsoon and bitter cold in winter. Climate deviation arises due to rapid urbanization, deforestation and accumulation of green house gases. Summers are hot and humid, with maximum temperatures exceed 40°C. Winter with lows plunging to 150C–18°C and the least is jumping to 8°C. For more than a decade now, it has experienced contrasting extreme weather conditions: from heat waves to cyclones, from droughts to floods. Floods have become an annual affair with the monsoon of 2001 leading to the worst ever flood recorded in Odisha in the past century, as 25 of the 30 districts were inundated affecting one third of the state's 30 million residents. Areas with no history of floods such as districts in western Odisha were submerged.

Climate Action Profile

Nature of Responses

Information and Advocacy

- Urban Flooding: In the Project: 'Integrated Urban Climate Action for Low-Carbon and Resilient Cities (Urban ACT)' which was the Successor to the Climate Smart Cities Project, the proposal in Bhubaneswar consisted of the the following 3 components to mitigate the challenges of urban flooding:
- A Digital Solution for the city - Citizen Cenric ICTA: Solution for Urban Flood;
- A Stormwater Drainage Master Plan for an upcoming Greenfield area
- A sponge city concept for the city to reduce water run off.
- Heat island effect: Heat island mapping was done followed by identification of areas for interventions

Agents of Change

Government	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) German Agency for International Cooperation or (GIZ) (international enterprise owned by the German Federal Government)
Other	Regional implementing Partners: UNESCAP, UCLG-ASPAC, University of Stuttgart, Technical University of Dortmund India Implementing Partner: NIUA, TERI

Funding Source

Federal Ministry for Economic Affairs and Climate Action (BMWK)
International Climate Initiative (IKI)

2 Kere-Baavi: Landscape of a Million Wells - Rural

Location

Banglore, India

Typology

Site, City, Intangible Heritage

Bio-geographic Zone

Deccan Plateau and Southern Peninsular Plains

Paddy cultivation in the landscape
Source- Presented in the webinar by Mr. Vishwanath Srikantaiah
Credits- Shared by Mr. Vishwanath Srikantaiah

Heritage Profile

In Kannada, 'Kere' means lakes or tanks, which are human constructs and 'Baavi' means open wells or dug wells. Bangalore, has a geological history of 3400 million years. The rocks, the altitude of the region, the particular kind of temperature and rainfall patterns, the soil and the entire landscape is what the inhabitants of the region worked with to create an ecosystem of a series lakes or tanks. In these landscapes, the cultural heritage, including built heritage and livelihoods, all interact with one another. Bangalore, for example is on a ridge line with 3 major valleys, Vrushabhavathi Valley, Koramangala Challaghatta Valley and Hebbal Valley, each valley has a set of tanks or water bodies, which are connected to each other. The watersheds for each one of these valleys are different from one another For example, the Vrushabhavathi Valley, is a steeply sloping one, the Koramangala Challaghatta Valley is less steeply sloping, and therefore the characteristics of the lakes in these two vallleys are very different. The landscape also has a history of inscription stones which date the tank or lake ecosystem. The human made landscape has evolved based on rainfall patterns, the valley systems and through the socio-cultural interactions of humans with nature.

Climate Change Profile

Impacts of climate change

Monsoon is becoming increasingly variable and erratic, drought followed by famine. For historic water structures, it is often seen that heritage in terms of the skeleton (the structure) remains, but the soul, which is the water disappears. Therefore the challenge is that there is an impact on the functionality of the heritage, leading to water insecurity.

Climate Action Profile

Nature of Responses

Demonstration projects/ Proving by doing

The tank ecosystem consists of a rainwater catchment, and there are dams for holding water in the valleys. The height of the tank is a carefuly crafted community construct between a series of tanks, ensuring only sufficient amount of water is held and the rest of the water is allowed to flow into the downstream tank. Agriculture, fishing, etc are dependant on the water. The tank ecosystem is a cultural practice, wherein 'Neerugantis' are people responsible for the decision-making regarding which crops should be grown, how much area should be irrigated and how should water be distributed, ensuring water that is an asset that nature has given that particular year is distributed uniformly to all fields. The float of 'Gangamma' is a cultural practice of building a temporary structure to worship water when the water overflowed from the tank. It is a village level celebration with every house contributing as it brings proposperity to the place and the people. The downstream of the tank have paddy fields, with women as the main workforce. The paddy fields and the entire cycle of paddy cultivation and harvest, forms the unbuilt landscape. During the process of paddy cultivation, songs are sung which is part of the intangible heritage of the place and its people. The tanks, water and fields form the built and unbuilt, tangible and intangible cultural landscape. While tanks held water on the surface, the wells released water which are held in the aquifers, below the surface. The water in the tanks seeped into the ground (into the shallow unconfined aquifer or the sponge) and the wells were built around it. The wells provided water when the tanks dried and also provided water for domestic and drinking purposes. The wells themselves had an architectural expression. A particular set of people who worked on making the well were the stone workers (Kallu Vaddar community) and another set of people dug the earth for the wells (Mannu Vaddar community). These wells provide drinking water security even when there was no rain or there was a drought as they tapped into the aquifer. If protected they can provide water for upto three years of failed rainfall. The water is also available for pastoralists, who are non-landholders but derive benefits from the water that is collected here. Points to consider: These systems were devised during feudatory times. Therefore if the systems are to be utilsed and rejuvenated in democratic times, some points must be addressed. When water comes to an ecosystem, by default it does not bring equity and justice with it. Water rewards those who have the largest land parcels. The more land one has, the more benefit one gets. Therefore when we intervene now, we have to keep in mind that the landless, the women, the Dalits, are people who should be integrated into this particular benefit that flows into a region.Therefore rehabilitation measures have to carefully crafted to be inclusive and just for all genders, caste, etc.

Innovation and social enterprises

Biome collaborates with women groups, particularly Dalit women, to create clean channels and boundaries for the tank ecosystem. These women draw the boundaries of the tank ecosystem and ensure equal distribution of water to all fields. By participating in tank rejuvenation and their heritage, women have a stake in the benefits, including wage work force and employment in paddy cultivation. Rejuvenation efforts should create agency, understanding, and livelihoods for those working with the ecosystem.

Agents of Change

NGO	Biome Trust
Other	People From the community

3 Kere-Baavi: Landscape of a Million Wells - City

Location

Banglore, India

Typology

Site, City, Intangible Heritage

Bio-geographic Zone

Deccan Plateau and Southern Peninsular Plains

Well in a farmer's field
Source- Presented in the webinar by Mr. Vishwanath Srikantaiah
Credits- Shared by Mr. Vishwanath Srikantaiah

Heritage Profile

The Kallu Vaddars community who were historically stone workers worked on making wells. The Mannu Vaddar community historically earned their livelihood through the craft of digging wells, cleaning and disinfecting them.

Climate Change Profile

Impacts of climate change

Due to high density of population in cities, there could be drought followed by famine [In the period from 1876 to 78 100,000 people died in the Old Mysore Kingdom. It was a devastating impact which led to the piped water supply coming into the city. The water tanks lost their prominence because they were no longer needed for water. The river started supplying water to the city. The borewell culture came in. With that the Mannu Vaddar community began to lose its livelihood earned through its practice of digging wells.

Nature of Responses

Innovation and social enterprises

Biome works with the Mannu Vaddar Community to ensure that the well digger families have jobs an livelihood opportunities through rejuvenation of historic open wells, through cleaning, desilting and disinfecting them; and also through digging new recharge wells. The rainwater harvesting policy in the city mandates that people either store rooftop rainwater or recharge it. Recharge wells are typically 1 meter or 3 feet in diameter and roughly about 6 meters or 20 feet deep. The well diggers have collectively made about 250,000 such recharge wells, to ensure that rainwater is directed into the aquifer, thus increasing the groundwater table and to reduce the possibilities of urban flooding. There is also a renewed interest in the heritage structures called Kalyanis, which are stepped wells. Biome is working with both the communities, mannu Vaddars and Kallu Vaddars to rejuvenate historic Kalyanis. One such example is the rejuvenation of the Kalyani close to Nandi hills which was in a state of disrepair, which is an example of shallow aquifer rejuvunation. This particular well can provide about a million litres of water in a constant series of pumping. It can reliably supply about 2000 families with the water required because the aquifer is conducive to recharging. Through this the historic structures also get functional rejuvenation. The practice of constructing wells in mud and lime is also being used again, without the use of cement or concrete.The other livelihood and set of people who are involved in keeping the lake/ tank clean are fishers and they are involved in making sure that macrophytes and water hyacinths are removed. Fisherpeople also make their livelihoods from the lake/ tank as it brings back the biodiversity into the lake.

Agents of Change

NGO	Biome Trust
Other	Mannu Vaddar Community

4 Kere-Baavi: Landscape of a Million Wells - Town

Location

Banglore, India

Typology

Site, City, Intangible Heritage

Bio-geographic Zone

Deccan Plateau and Southern Peninsular Plains

Heritage Profile

The entire landscape of Bangalore urban and Bangalore rural is located within a larger ecosystem of a series lakes or tanks. Bangalore, has a geological history of 3400 million years. The rocks, the altitude of the region, the particular kind of temperature and rainfall patterns, the soil and the entire landscape is what the inhabitants of the region worked with to create the ecosystem. In these landscapes, the cultural heritage, including built heritage and livelihoods, all interact with one another.

Climate Change Profile

Impacts of climate change

Due to high density of population in cities, there could be drought followed by famine [In the period from 1876 to 78 100,000 people died in the Old Mysore Kingdom. It was a devastating impact which led to the piped water supply coming into the city. The water tanks lost their prominence because they were no longer needed for water. The river started supplying water to the city. The borewell culture came in. With that the Mannu Vaddar community began to lose its livelihood earned through its practice of digging wells.

Nature of Responses

Demonstration projects/ Proving by doing

One of the ways in which Bangalore is imagining itself is as a water and fertilizer factory. A set of more than 35 decentralised sewage treatment plants (existing and planned) are spread all across the city of Bangalore. These sewage treatment plants plan to eventually pump treated water to a distance of about 100km to fill about 500 lakes in the surrounding drought prone, climate change affected districts of Kolar and Chikkaballapura, eventually making it world's second largest projects of its kind, next to the one in Mexico City. An existing example is a an existing network of lakes filled with treated wastewater in Bangalore rural. These lakes are about 1000-1200 year old and are part of the cultural landscape of the region. One of the lakes is a small lake next to the Devanahalli fort. Water supply at present in Devanahalli town which has a population of about about 40,000 people has about 120 bore wells which have gone to 1200 feet depth. Water is very saline and unpotable, so people rely on RO plants for the purpose of drinking water. In this project, secondary treated domestic water from the sewage treatment plant is brought to the lake (Sihineeru Kere) utilised for ground water recharge. Before utlilization of the lake it was desilted. There was an existing open well, from which debris was cleaned and rejuvenated. The community of well diggers was appointed for this. Meters were fixed to the well, a water treatment plant was set up, thereby integrating the shallow aquifer to the water supply system which is used for drinking purposes.

Innovation and social enterprises

This system integrates the historic water management system of the lake, well and the community-held knwoledge system of well digging an dconstruction with modern technology. Water quality testing is done to ensure the quality of water is fit for drinking purposes as this is one of the first watewater to drinking water projects of India.

Agents of Change

Government	Bangalore Water Supply and Sewerage Board (BWSSB)
NGO	Biome Trust

5 Past Imaginations for a Fertile Future: Hampi

Location

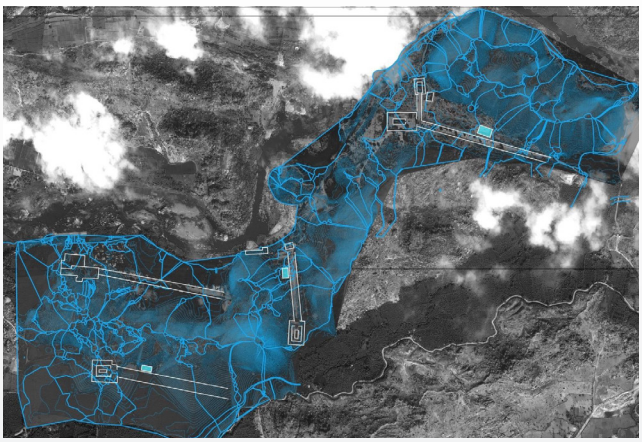
Hampi, India

Typology

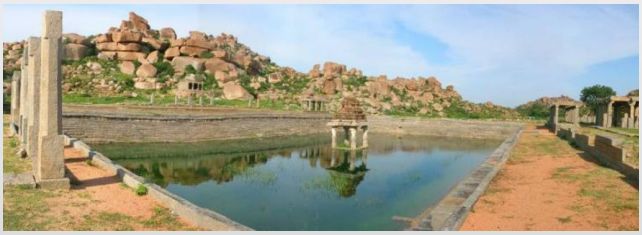
Site, City

Bio-geographic Zone

Deccan Plateau and Southern Peninsular Plains



Mapping the dynamic relationships of the precinct indicating natural systems and watershed patterns
Source- Presented in the webinar by Mr. Mohan Rao
Credits- Intergrated Design



Revived Pushkarini through historical interpretations of the natural order of systems, Hampi, Karnataka
Source- Presented in the webinar by Mr. Mohan Rao
Credits- Intergrated Design

Heritage Profile

Known as the capital of the Vijaynagara Empire between the 14th and 16th century CE, the group of 56 monuments in Hampi was inscribed in UNESCO's World Heritage List in 1986. The inscribed area, its core and buffer zone cover not only the ruins of the erstwhile capital city, but also the spectacular setting including its natural features and 29 settlements with over 6,00,000 inhabitants. The property is located in the Tungabhadra river basin in Central Karnataka, Bellary District. The significance of the site presents complex inter-relationships between the natural environment and human interventions, expressed both in tangible and intangible forms. The process of occupation of this landscape indicates that there are several systems layered within the landscape such as hyrological landscapes and water management systems, irrigation canals, productive landscapes, territorial organisation, a series of urban cores connected to a larger whole, etc.

Climate Change Profile

Impacts of climate change

Due to the semi-arid climate of the region, it is extremely vulnerable to heat stress, droughts and occassional flash floods. Projected scenarios for the peninsular region is likely to exacerbate water shortage, reduced soil fertility and erosion along with increased heat stress.

Climate Action Profile

Nature of Responses

Demonstration projects/ Proving by doing

- The main focus of the conservation program was revival of the 'Pushkarani', the ritual stepped-tank along the bazaar axis of Vittalapura. Conservation of the Ceremonial Tank was done wherein, the conservation of the structure was accompanied with an attempt to revive the water management system through a series of interventions in the landscape. The exercise combined issues of heritage conservation, hydro-geology, ecological planning and tourism infrastructure.

Innovation and social enterprises

- Reviving centuries old passive management systems to address water security; address soil, water and vegetation management using an integrated approach.

Agents of Change

Government	ASI, Bangalore Circle
Private sector	Integrated Design (INDÉ), Bangalore

Funding Source

ASI, Bangalore Circle

6 Climate Responsive Vernacular Houses – Pol Houses of Ahmedabad

Location

Ahmedabad, Gujarat, India

Typology

City, Building and Structure

Bio-geographic Zone

Semi-Arid Zone

Heritage Profile

The Pol Houses of Ahmedabad are a vernacular housing typology within the World Heritage Property of the Historic City of Ahmedabad. The house typology and the dense settlement pattern are known to be climatically suitable for a semi-arid zone.

Climate Change Profile

Impacts of climate change

Vernacular Pol House Typology - Primary focus of the design is thermal comfort, not for energy efficiency.

Rising Wet Bulb Temperature - In addition to rising heat and heat waves, the wet bulb temperature, is nearing the threshold of human comfort. In vernacular houses, where lime is used and relatively less ventilation is available as compared to contemporary houses, the rising wet bulb temperature becomes a factor of concern. Combination of heat and humidity is challenging to manage.

Nature of Responses

Demonstration projects/ Proving by doing

- Research and scientific analysis was done to calculate thermal comfort and performance of the vernacular 'Pol House' typology of the World Heritage Property of the Historic City of Ahmedabad.
- The analysis includes - a study of dry bulb temperature and relative humidity in the Pol Houses. The study indicates that in addition to cooling, dehumidification is also required for thermal comfort.
- The study of the Pol House also includes - an analysis of indoor air temperatures; indoor versus outdoor air temperatures; thermal comfort levels; natural ventilation required for thermal comfort; a study of cooling needs to meet adaptive thermal comfort ran ge.
- The study indicates air temperature and relative humidity are not enough to understand thermal performance of Pol houses. Mean radiant temperature, moisture buffering capacity, dense urban settlement and impacts of urban heat island effect also need to be studied.

Agents of Change

Others	CEPT University (Prof. Rajan Rawal)

7 Resource Conscious Adaptation of Kath-Kuni Houses

Location

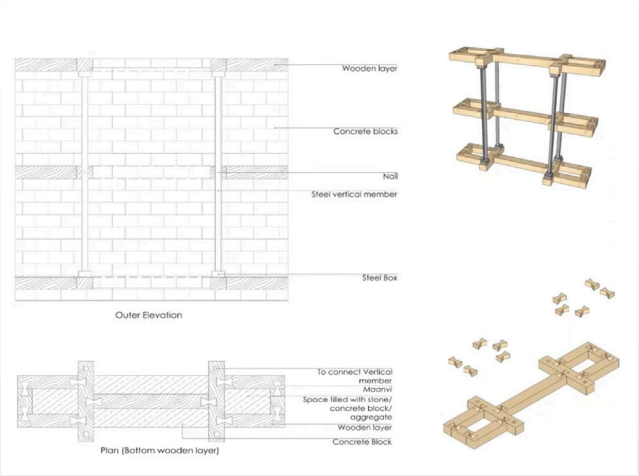
Himalayas, Uttarakhand and Himachal Pradesh

Typology

Building and Structure, Intangible Heritage (Building Craft)

Bio-geographic Zone

Himalayan Mountain Range



Reinterpreted System

Source- Presented in the webinar by Sanjay Chikermane
Credits- Survesh Chetiwal, PhD Student, IIT Roorkee

Heritage Profile

Kath-kuni houses, are a vernacular housing typology. Wood and stone are the primary building materials used for this building typology. Deodar is the prefered wood to be used for the structural system. The construction technique and structural system of the typology is known to be resilient to seismic action. It also provides a long life to the building typology.

Climate Change Profile

Impacts of climate change

Large quantity of wood used in the construction system, Deforestation leading to various climate related issues .
Availability of Building Materials - The construction technique uses large quantities of wood, continued use of which may lead to increase in deforestation, thereby adversely affecting climate change.
Structural Behaviour - Impacts of earthquake can act as risk multipliers to areas affected by climate induced hazards

Climate Action Profile

Nature of Responses

Demonstration projects/ Proving by doing

- The construction system including materials, construction elements and details of the vernacular housing typology were studied;
- The structural behaviour, structural attributes and failure patterns were studied in detail;
- For a resource conscious adaptation of the structural system, a reinterpretion of the structural system was done through designing details that ensured an approximately 25 to 30 % reduce in the quantity of wood used in the structural system;
- The design innovation was tested in a simulated environment as well as in a live project through introduction of the reinterpreted structural system in - retrofitting of damaged structures as well as in design and construction of new structures.

Innovation and social enterprises

Adaptation - Through scientific analysis, an innvotive reinterpretation of the vernacular construction and sructural system was done, such that the houses can adapt to the issue of excessive consumption of wood as a building resource.

Agents of Change

Educational Institution	Indian Institute of Technology Roorkee (IITR) - Dr. Sanjay Chikermane (IITR)
Others	Survesh Chetiwal, Marloes van der Zanden, Kiran Vaghela, Shubham, Digambar Chauhan, DCOOP Architects, Mumbai

Funding Source

National Mission on Himalayan Studies (NMHS)

8 ICCROM's Project Net Zero – Jodhpur

Location	Typology	Bio-geographic Zone
Jodhpur, India	City	Desert/ Arid Zone

Heritage Profile

This is the second largest city in the Indian state of Rajasthan, located in the desert landscape of the Thar Desert.

Climate Change Profile

Impacts of climate change

Traditional Water Harvesting Structures and Water Management Systems - These systems and networks have broken or are not is active use or are not in a good state of conservation leading to water insecurity Place-based and traditional Knowledge Systems - Insufficient integration of place-based and traditional knowledge systems in existing policies to tackle impacts of climate change in the city.

Climate Action Profile

Nature of Responses

Information and Advocacy

- The projects aims to disseminate its research regarding what would be a culturally sensitive and appropriate Heat Action Plan for Jodhpur

Innovation and social enterprises

- Aim of the innovation project is to mainstream place-based knowledge and traditional practices into a policy, the Heat Action Plan
- Steps include - research and stakeholder consultation
- Architectural study of how the traditional construction systems can be incorporated into the Heat Action Plan
- Study of traditional water harvesting and management systems, whether and how they can be revived

Agents of Change

NGO	ICCROM's flagship programme on First Aid and Resilience (FAR) launched the multi-partner capacity development initiative 'Net Zero: Heritage for Climate Action'

Funding Source

Supported by Swedish Postcode Foundation.
In partnership with

- The Culture and Museum Division of the Ministry of Internal Affairs of the Republic, Kiribati
- Casa K'ojom, Guatemala
- Leadership for Environment and Development (LEAD) India
- Confederation of Risk Reduction Professionals (CRRP), India
- The School of Architecture of Federal University of Minas Gerais (UFMG), Brazil
- The State Institute of Historical and Artistic Heritage of Minas Gerais (IEPHA-MG) Brazil
- Local Governments for Sustainability - South American Secretariat (ICLEI), Brazil

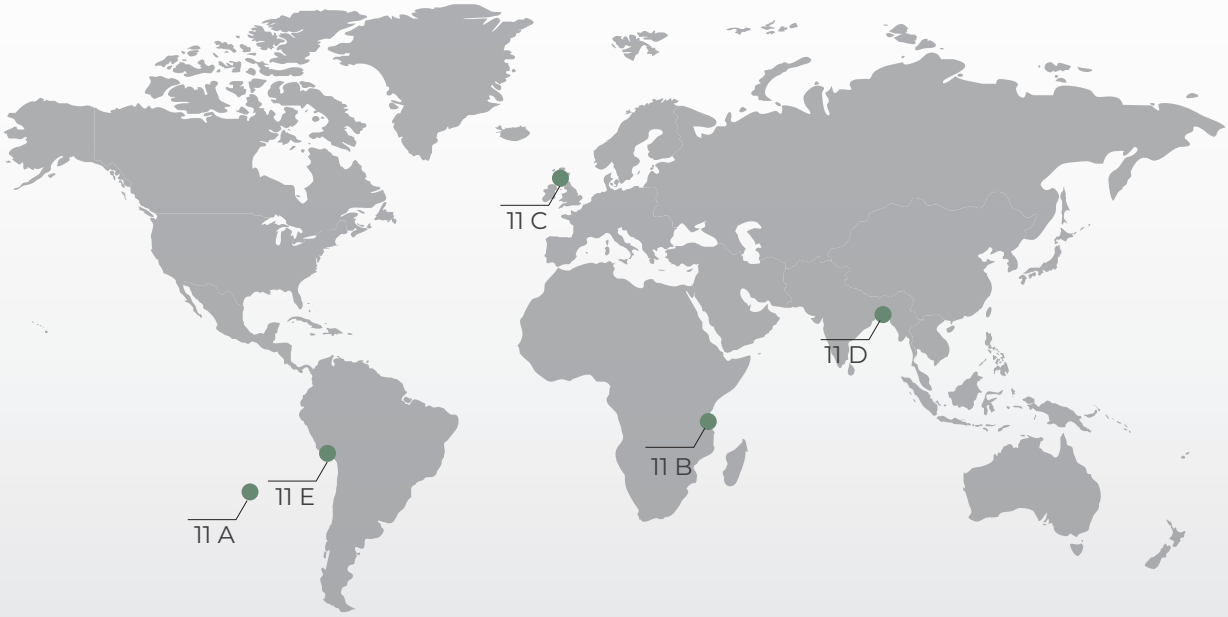
9 Heritage on the Edge Project

Location

Chile, Tanzania, Scotland, Bangladesh, Peru

Typology

Landscape, Site, City, Monument/ Building/ Structure



Heritage Profile

A). Rapa Nui National Park (Chile): Rapa Nui is known for its iconic ahu (platforms), and their moai (statues). There are approximately 900 moai or statues and over 300 ahu or ceremonial platforms, a maximum numbers of which are located along the coast. The site has several elements that are assocaited with funerary practices. The site also has other archaeological sites including rock art panels.

B). Ruins of Kilwa Kisiwani and Ruins of Songo Mnara (Tanzania): Located on two islands, these site are remnants of the impressive port cities of Kilwa Kiswani and Songowas Mnara on the eastern coast of Africa. These were Swahili trading cities whose prosperity was based on the Indian ocean maritime trade. The prosperity of the cities reached its peak between the 13th and 16th centuries.

C). Old and New Towns of Edinburgh (Scotland, UK): Since 15th century, Edinburgh has been the capital of Scotland. The city has two distinct areas: the Old Town, with a medieval fortress; and the neoclassical New Town, which developed from the 18th century onwards. The juxtaposition of these two historic areas, gives the city its unique character.

D). Historic Mosque City of Bagerhat (Bangladesh): The Historic Mosque City of Bagerhat is located in the south-west part of present Bagerhat district of Bangladesh, at the confluence of the Ganges and Brahmaputra rivers. The city, wich was earlier known as Khalifatabad, flourished in the 15th century CE.The city consists of 360 mosques, public buildings, mausoleums, bridges, roads and water tanks.

E).Chan Chan Archaelogical Zone (Peru): Chan Chan was the capital city of the Chimu empire, which reached its apogee in the 15th century. This was the largest earthen architecture city in pre-Columbian America. The Outstanding Universal Value of the city includes its city planning and remnants of its industrial, agricultural and innovative water management systems.

Climate Change Profile

Impacts of climate change

In all the cases, heritage serves as a lens to better understand the impacts of climate change on people and communities.

A). Rapa Nui National Park (Chile): Most of of Rapa Nui's material heritage is along the coast, making it extremely vulnerable to rising sea levels and coastal erosion. The island has a mineral poor soil which runs off into the ocean with heavyy rains; Rapa Nui is a living landscape and the maoi continue to be very important to the local people who are the decendents of the original Rapa Nui. The loss of material heritage will lead to loss of spiritual and associational values of the site; the loss of the heritage would also have a huge impact on the livelihoods of the people dependant on the island's tourist economy; the carrying capacity of the island is of concern due to the population and increase in tourism, as issues of water scarcity and waste production are increasing. There are no permanent streams or rivers making water provision an issue; Low rainfall in 2017 followed by a dry year in 2018, led to the freshwater lake in the Rano Raraku crater getting dried up.

B). Ruins of Kilwa Kisiwani and Ruins of Songo Mnara (Tanzania): Sea-level rise and coastal erosion exacerbated by land-use practices has resulted in the loss of some structures and archaeological deposits; The foundations of the structures (such as the 15thc Malindi Mosque and the Gereza) have been impacted by coastal erosion caused by wave action.

C). Old and New Towns of Edinburgh (Scotland UK): The castle of Edinburgh is built on a volcanic rock, which is vulnerable to increased rainfall, leading to landslides and flooding. The stone masonry of the buildings of the city use porous sandstone which is vulnerable to increase in levels of precipitation leading to increased wetting and drying periods which can lead to the decay of these stones.

D). Historic Mosque City of Bagerhat (Bangladesh): Situated in the cusp of the tidally active Ganges delta, the city is vulnerable to sea level rise and resultant salinity ingress impacting the structures; salinity ingress is also negatively impacting the health and wellbeing of the people who live around the site.

E). Chan Chan Archaelogical Zone (Peru): Extreme weather events caused by El Niño, a climate cycle in the Pacific Ocean, includes increse in precipitation events and rainfall variability, leading to erosion of earthen architecture as well as a rise in the water table at the site. The earthern architecture is vulnerable to storms and torrential rains.

Climate Action Profile

Nature of Responses

Information and Advocacy

The project is an online platform to digitally document the impact of climate change 5 World Heritage Sites. Detailed 3d models of these sites was created and then used to create an interactive online platform. The emphasis of the project was that these sites can be lenses through which the wider impacts of climate change and the role of heriatage in responding to it can be understood. The aim of the project was: 1). To make a space for local voices from sites to discuss the impacts of climate change in a human-centred way; 2). To use innovative technologies to encourage enagagement with heritage and stress urgency about climate change; 3). To use the power of iconic places and heritage to promote climate action; 4). To catalogue to share the global nature and wide impacts of climate change; 5). To collect data for the sites which can be used for ongoing monitoring and adaptation efforts.

Agents of Change

Private	CyArk
NGO	ICOMOS Climate Change and Heritage Working Group

Funding Source

Google Arts and Culture

10 Project: Net Zero – Heritage for Climate Action

Location

Brazil, Egypt, India, Sudan,Uganda

Typology

Site, City, Intangible Heritage

Heritage Profile

A). Ubatuba, Brazil: The site is a natural rainforest reserve near São Paulo, that has significant water resources. Ubatuba has an approximately 100 km coastline.
B). Rosetta, Egypt: This is a port city and a World Heritage Site located in the Nile Delta. Its a settlement in the bio-diverse delta and was known as the food-bowl of Egypt.
C). Jodhpur, India: This is the second largest city in the Indian state of Rajasthan, located in the desert landscape of the Thar Desert;
D). Tuti Island, Sudan: The island is located at the confluence of the White and Blue Nile rivers in Sudan near Khartoum, Omdurman and Khartoum North.
E). Kasese, Uganda: The Kasese district has the sacred cultural site 'Ekyisalhalha Kya Kororo'.

Climate Change Profile

Impacts of climate change

A). Ubatuba, Brazil: food insecurity due to varied climate change related hazards and extreme weather events;
B). Rosetta, Egypt: rising sea levels, storms and increased salinity of river water;
C). Jodhpur, India: cyclic droughts, extreme heat and water scarcity;
D). Tuti Island, Sudan: increased temperatures, prolonged droughts, cyclic floods and sea level rise;
E). Kasese, Uganda: irregular rainfall patterns and glacial melting of Rwenzori mountains leading to cyclic floods

Rosetta, Egypt: Building of a high dam stopped the flooding of the Nile Delta on which the farmers were dependent, leading to a loss of soil fertility. Oil and gas explorations are also ongoing in the area. Climate projection studied in Phase 1 of the Project, indicate that Rosetta in next, 50 to 100 years can become unliveable. Sea level rise, water scarcity, increased extreme weather events, food insecurity and famine are all possibilities. In order to retain the land and protect the built heritage engineering solutions have been prioritized in the past, but some of these solutions have not been effective, rather have contributed to furthering soil infertility. Lived experiences and traditional practices of the indigenous people will be recorded, however, the population is ageing therefore the time to do so is limited. The knowledge of this generation needs to be tapped into as a climate chance.

Climate Action Profile

Nature of Responses

Demonstration projects/ Proving by doing

- Using indigenous knowledge and traditional practices, the team aims to reduce: the risks of drought and flood related disasters; food insecurity, environmental degradation, carbon emissions, forced migration, conflict over resources, extreme heat events. The project is planned to have 5 phases: Phase1- Situation analysis and data gathering; Phase 2: 4 week in-person workshop; Phase 3: Strategies for culture-based climate action; Phase 4: Final international symposium and publication.

Innovation and social enterprises

- Ubatuba, Brazil: The project aims to tap into the knowledge held by the Quilombola communities to devise measures to preserve crop diversity in Ubatula. Through a an understanding of the inter-realtion between community-held knowledge and scientific data, the team will device inventory systems and seed banks of native species to mitigate food insecurity;
- Rosetta, Egypt: The project aims to evaluate the vernacular architectural practices and traditional fishing practices and patterns to device strategies to reduce the impacts of climate change on the livelihoods of local communities; Within the limited duration of the project the following components will be done a. The climate chance project has been named HAYA which aims to tap into the traditional knowledge, plant Sycamore trees to reduce soil salinity and revive the practice of cultural gatherings around the trees; b. An early warning app for flood warning using traditional symbols will be developed; c. The project will foster inter-generational traditional knowledge transmisson on coping with floods and extreme heat
- Jodhpur, India: The project team will map the community-held knowledge of building climate-responsive settlements towards devising interventions that can aid the process of mitigating extreme heat-related events. The project also aims to explore the potential of utilising the city's traditional water management systems to reduce cyclic droughts and water insecurity. The findings will be utised to develop a Heat Action Plan (HAP) for the city;
- Tuti Island, Sudan: The project aims to use indigenous community-led early warning system known as Taya and link it with modern technology towards reducing the impacts of cyclic flooding and enhancing resilience of the communities and peace;
- Kasese, Uganda: The project aims to utilise the lived experiences and community-held knowledge of the Bakonzo community, on planting patterns and preservation of native plant species towards maximising carbon sequestration, reducing and controlling riverbank erosion and enhancing biodiversity.

Agents of Change

Others	1). Ubatuba, Brazil: The team includes: Representatives of the Quilombola community, Public Archaeology Laboratory (LAP) at the Centre fro Environmental Studies; University State of Campinas (UNICAMP) for research; ICOMOS Brazil, Climate Change and Heritage Committee, Secretariat of Agriculture and Supply of the State of São Paolo (IAC)

Funding Source

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The Culture and Museum Division of the Ministry of Internal Affairs of the Republic, Kiribati
Casa K'ojom, Guatemala
Leadership for Environment and Development (LEAD) India
Confederation of Risk Reduction Professionals (CRRP)

	Centro Nacional de Monitoramento e Alertas de Desastres Naturals - CEMADEN, The State University of Golas' history department 2). Rosetta, Egypt: The team includes: Representatives of the fishing community; Egyptian Heritage Rescue Foundation (EHRF), Cairo University's Community and Environment Section, National Authority for Remote Sensinh in Egypt; 3). Jodhpur, India: The team includes: Risk and Resilience Institute (RRI), Confederation of Risk Reduction Professionals (CRRP); National Research Development Corporation (NRDC); Mahila Housing Trust (MHT), Local Municipal Corporation; 4). Tuti Island, Sudan: The team includes: Sudan Urban Development Think Tank (SUDTT), Studio Urban, University of Khartoum, Resurgence, United Nations Development Programme (UNDP) 5). Kasese, Uganda: The team includes: Bakonzo Community leaders, Obusinga Bwa Rwenzururu, the cultural institution of the Bakonzo, Cross-Cultural Foundation of Ugnanda (CCFU), Uganda, Wildlife Authority (UWA), Kasese District Local Government Authority
NGO	ICCROM's flagship programme on First Aid and Resilience (FAR)

The School of Architecture of Federal University of Minas Gerais (UFMG), Brazil
The State Institute of Historical and Artistic Heritage of Minas Gerais (IEPHA-MG) Brazil
Local Governments for Sustainability - South American Secretariat (ICLEI), Brazil

Part D

Key Takeaways

Key Points

Climate Change and its Impacts

A Summary of Implicit Learnings and Applications From the Case Studies

Key Points

Recognizing the Intersection between Climate Change and Cultural Heritage

India is a Party to the United Nations Framework Convention on Climate Change, its Kyoto Protocol and Paris Agreement and as a part of this India has submitted its Nationally Determined Contribution balancing the concerns and priorities of climate change, sustainable development, including poverty eradication, and economic growth of the country (PIB Delhi, February 2023). National Action Plan on Climate Change (NAPCC), and State Action Plans for Climate Change (SAPCC) are concrete steps towards that. The National Adaptation Fund for Climate Change (NAFCC) has also been set up since then to support adaptation activities un the State and Union Territories. Each of these action plans work towards adaptation measure for places and are lead by the Local Governing Bodies. Climate Change, however, also manifests as frequent disaster events and the National Disaster Management Authority has been preparing specific plans to assist stake holders to address various risks and hazards. It is under this broad framework is the concern for cultural heritage in context of climate change situated. And like many have argued, while we need to systematically address the impacts of climate change on India's cultural heritage, we must also recognize that cultural heritage and the traditional knowledge embedded there-in, provides lessons and opportunities to mitigate climate change.

Climate Change Events Typically Affecting Cultural Heritage

Climate change has world over affected historic sites and places, in some cases have rendered them inaccessible. The most known effect of climate change, sea level rise has affected cities like Lamu old town in Kenya, Santo Domigo in Dominican Republic, Venice and Rotterdam, threatening them with regular flooding of sea water. High sea tides have also affected cities like Hue in Vietnam, and Georgetown in Malaysia by eroding the coastline and in some cases, causing salt water flooding that results into sand encroachment and erosion of land. In these cities, there are measures being made to systematically relocate people into safer areas. Closer to home, Sagar Island, a part of Sundarbans is getting affected by saltwater flooding that is affecting and eroding the ecosystems of the place.

Places in Peru, Historic Center of Prague, Paris, Edinburgh, Mexico City, historic sites Iraq and Algeria, and Po River Valley in Italy get flooded regularly due to intense precipitation and erratic heavy rainfalls. This is also true for many Indian cities and historic places such as Bhubaneshwar, Bangalore, and Historic Sites in Kerala among many others. Heavy precipitation in itself causes adverse effect to these historic fabrics that have been traditionally constructed for dry climatic conditions. Other extreme events that are attributed to climate change include storms, cyclones, droughts, heatwaves whose impacts on historic sites, in many cases is compounded by the fact that many of these places lie in earthquake prone areas.

The other, more gradual effects of climate change include temperature changes, dryer summers, wetter winters, heavier precipitation have shown impacts in built heritage in more subtle and slow ways. For example, erosion of structures that eventually threaten to render them unusable and in some cases the compounded affect result into collapse of buildings. Cumulatively impacts of climate change on historic cities add to the existing challenges of dereliction, infrastructure pressures, quality of life, economic loss, and loss of the community network that hold the knowledge of mitigating and adapting to emergencies.

Recognizing Impacts of Climate Change on Cultural Heritage

In the best case scenario, the impact of climate change on cultural heritage is an acceleration of the erosion of historic fabric and in the worst case, complete loss. Most impacts range in the middle of these extremes. The Chan Chan Arcaheological Zone in Peru, Edinburgh, and Paris, the acceleration of erosion of historic structures

is recorded. In India, similar studies are conducted on the Kath-Kuni houses of Uttarakhand. The traditional earther architecture of Timbaktu in Mali, pre – Hispanic architecture of Peru, and historic fabric of Lamu old town in Kenya are already lost owing to this accelerated deterioration.

Flooding of historic cities damages its already pressured infrastructure and housing, heat waves and other extreme temperature conditions makes it difficult for people to live in the houses that were made for other climatic conditions. Climate Change also impacts the natural and traditional water systems adversely and in many cases that poses a more immediate threat and adds to the vulnerability of historic places. In Mexico City, the depletion of the aquifer compounded by the seismic instability is resulting into a gradual sinking of the entire city. Depleting traditional open wells of Karnataka, overflooding of stepwells in Rajasthan and Gujarat affect the fabric and the knowledge systems that worked closely with the environment. In the long run, these impacts result into loss of historic information, what is known as traditional knowledge system, that brings the community together and gives them the ability to be resilient in such situations.

Appreciating Cultural Heritage as a Resource

Cultural heritage practices, around the built environment and its water systems, along with the practices of agriculture, waste management and other aspects of life are closely connected to nature. In order to address the impacts of climate change on historic cities it is important to understand and appreciate this heritage. The traditional water management of Bangalore and its surrounding landscape, for example, is a very well thought out ecosystem of tanks that catch the rainwater and small dams that hold water in the valleys. Infrastructural interventions that are not cognizant of this have accelerated the flooding instances in Bangalore city and have caused serious damage to the quality of life and economy of the city.

The example of Bangalore water system also shows that the knowledge of the details of this system is embedded in the cultural practices of the Neeruganti community. Advantages of involving communities in rebuilding cultural practices to mitigate and adapt historic places is also seen through the examples like Lamu in Kenya, Iraq, Nigeria. Knowledge of the relationship between nature and culture, along with social connections that possibly make a resilient future are embedded in behaviors and knowledge of the communities and must be acknowledged. Having said that, it also must be noted that this knowledge is layered with gender, race and caste hierarchies which must be addressed.

Need for Scientific Processes for Diagnosis

Borrowing from the approach of sociologist, environmentalist and town planner, Patrick Geddes, any action must start with a 'diagnostic survey'. Most successful action plans, as established through various case studies start with a well-researched understanding of the impacts of climate change on heritage and possible mitigation and adaptation measures. Po Valley Project in Italy, for example, was based on a research and monitoring system for damage assessment that mapped significant risks for the district. The Project then used scientific tools and methods for corroborating data and relied heavily on visualizing damage result. Along with a process of diagnosing damage to heritage assets it would also be important to map and assess the embedded lessons of resilience and management within the tangible and intangible aspects of cultural heritage.

Acknowledging the Need for Systematic Planning and Monitoring

Most case studies presented in the compendium depend on systemic planning based on scientific evidences. Peru, for example has a clear management plan with multiple layers of action, from awareness building, mitigation measures, adaptation strategies to monitoring. In the city of Paris this plan of action is supported by a Sustainable Development Guidelines to advise the municipalities to take appropriate decisions. Edinburgh on the other hand works with the existing framework of governance and has taken a step change approach to

build a robust system of management that will respond to challenges of climate change. Cities like Prague and George town also have specific risk response and management plans for extreme events of flooding. Heritage sites in Nigeria and Algeria, specifically the M'Zab Valley site, have reworked their Conservation Management Plans to be include the specific challenges of climate change impact on heritage while being aware of the resilient community frameworks.

Nature Based Mitigation of Climate Change

Mitigation measures are characterized as efforts that will reduce the impacts of climate change on human health and safety. Risk to life in all circumstances gets prioritized. The risk of life in gradually sinking Mexico City, or the risks of quality of life related to frequent flooding and heat waves in cities like Georgetown require immediate mitigation measures to ensure that the impacts on climate change does not threated human life. In certain circumstances, it may also be accepted that there may be loss of historic place. Georgetown responds to this by keeping a good record of all information about the heritage of the city updated and with multiple backups. Digital tools can be of great use for such record keeping and to plan mitigation measures better.

Cities have identified specific threats to cultural heritage and historic sites to provide specific mitigation measures that will prevent further damage, like flood barriers in places that flood and specific risk action plans for other extreme events. Ayutthaya in Thailand, plans its mitigation around community networks and suggests nature based solutions for mitigation while using the latest digital technologies for data management and monitoring.

Adaptation of Heritage Places

Historic Places, in order to respond to the gradual changes in climate, such as changes in temperature, wind, and precipitation, also have to undertake adaptation measures that will reduce risk to human life while conserving the heritage. In Peru, for example foundations of historic structures are repaired to increase the life of heritage buildings. In Sagar island, the water system is adapted by introducing six interlinked ponds to preserve the island ecology. The case study of the research done to adapt the vernacular architecture of Uttarakhand presents a case of adaptation while considering current safety standards and with consideration of limited resource availability. In many examples, historic buildings are adapted for fire safety, earthquake safety, early alert systems, and upgraded infrastructure for better quality of life. These adaptation measures are crucial for a continued economic and social health of historic cities.

Multi-Stakeholder Action and Capacity Building

As it is reflected in all case studies presented, the action for climate change mitigation and adaptation of historic cities, while being cognizant of conservation of cultural heritage needs multiple stakeholders; from universities, research centers, educational institutes, government bodies, non-government organizations, private sector, and most importantly, the communities. Each city, while presenting unique challenges, requires to pivot their actions towards addressing them. The framework for the Climate change action for cultural heritage will need a framework that is supported by the capacities to address these challenges.

Embracing Digital Technologies for Climate Action

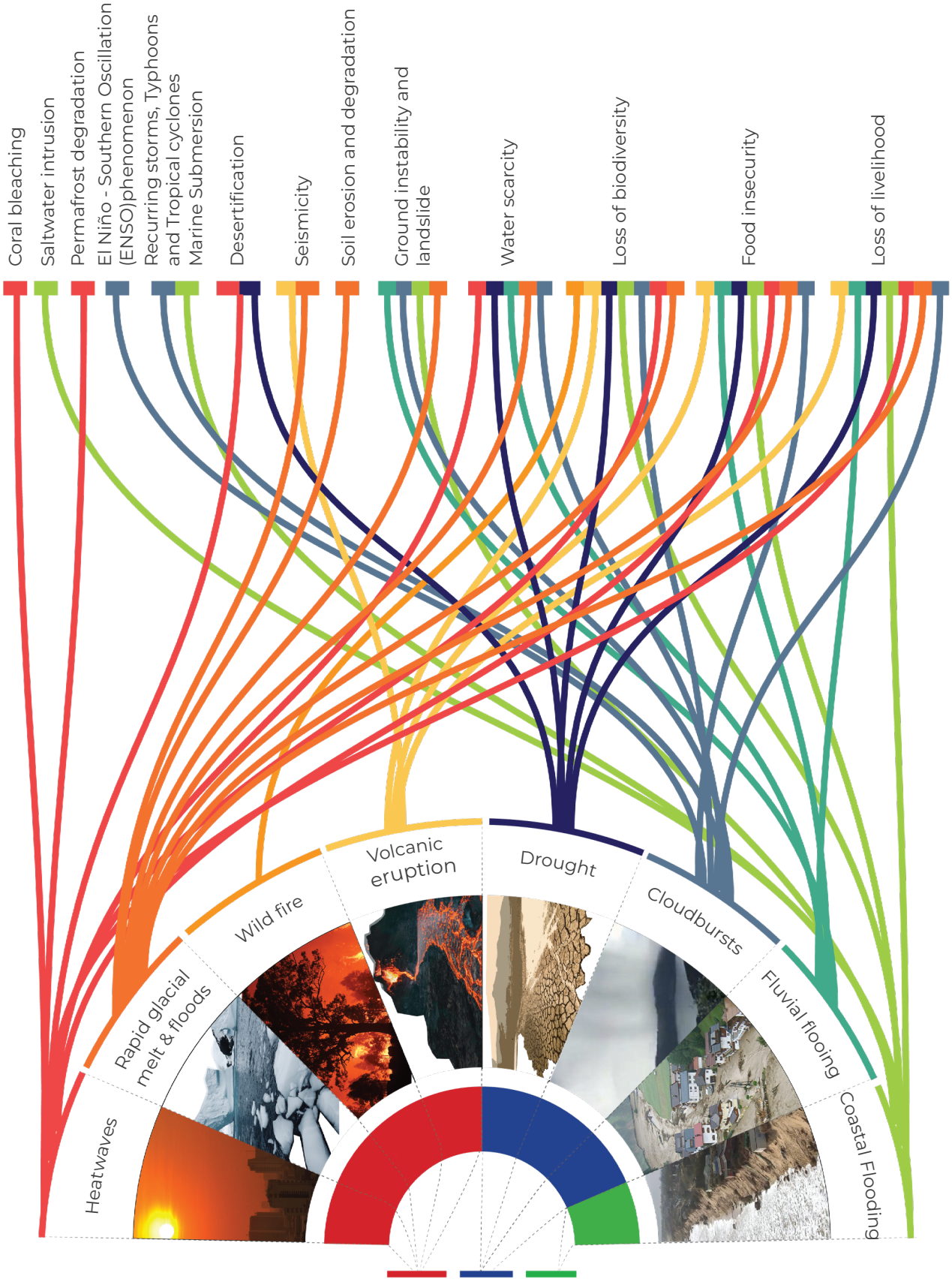
Multi stakeholder action in the complex process of climate action in historic cities require new tools of rewarding, documentation, scientific assessment and scenario building for assessing future threats and challenges. Many identified case studies, such as Safina project - Art for Iraq and 3D4heritage, India propose digital tools for data gathering, analysis, modeling and monitoring. Embracing these process as a part of governance and building capacities to that end will enhance the chances of capturing traditional wisdom and conserving cultural heritage in context of climate change.

Considering Existing and Past Frameworks and Resources as a Springing Point

In the last decade, various ministries in Government of India, with support from NIUA, have introduced schemes and programmes for upgrading the city infrastructure, while dealing with the challenges of inclusivity and sustainability. One such scheme was introduced by Ministry of Housing and Urban Affairs in 2015, Heritage City Development and Augumentation Yojana (HRIDAY) that exclusively focused on upgrading infrastructure of twelve historic cities. This was the first scheme to look into the historic cities and recognise the need to create better quality of life while concerning the heritage. The scheme was also unique as it places the essential historic character of the cities as sites of experience of culture at the centre of development schemes.

Considering this new challenge of intersection between climate change and cultural heritage, this scheme and its framework could act as a point of departure. There have been many lessons learnt from the schemes and its action plans in the twelve cities that point towards better integration, sustainability and better governance models. Existing resources and systems of governance need to be examined and harnessed to addressed the new challenges posed by climate change. The new framework to be proposed as a result of this exercise for climate action for cultural heritage could also very well branch out from the CITIIS program (2.0) that considers climate action as one of its primary components.

Climate Change and its Impacts



A Summary of Implicit Learnings and Applications From the Case Studies

Enablers Barriers

Enablers

- Funding - Art councils, governments, banks, foundations/ philanthropy
- Public/ community engagement
- Continuous data monitoring/ CVI assessments
- Leveraging local indigenous knowledge for data collection/ monitoring
- Communication and knowledge transfer
- Strategic partnerships and networks
- Setting climate action targets/ agendas
- Urgency/ severity of vulnerability as a driver of innovation
- Channels for integrating and mainstreaming traditional knowledge systems in urban contexts
- Acknowledging nature as a driver of innovation for climate resilience
- International and national recognition as safeguards
- Financial gains

Barriers

- Not recognizing certain strains/ indicators as critical enough to take action such as erosion
- Lack of convergence with initiatives
- Lack of a climate action lens to development projects and initiatives taken up in urban areas
- Data transparency
- Lack of acknowledgment/ recognition for traditional knowledge systems to solve urban issues
- Lack of urgency for preparedness and mitigation as opposed to damage control
- Funding constraints resulting in piecemeal quick fixes as opposed to a long-term holistic approach
- Lack of stakeholder consensus leading to poor compliance for statutory measures
- Lack of resources for periodic revisions of city plans
- Low levels of accountability for action
- Low levels of awareness among stakeholders
- Communication and outreach being undervalued actions
- Nomenclature

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Glossary

Cultural and Natural Heritage

Cultural and natural heritage are defined in Articles 1 and 2 of the World Heritage Convention.

Article 1

For the purposes of this Convention, the following shall be considered as "cultural heritage";

- Monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of Outstanding Universal Value from the point of view of history, art or science;
- Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of Outstanding Universal Value from the point of view of history, art or science;
- Sites: works of man or the combined works of nature and of man, and areas including archaeological sites which are of Outstanding Universal Value from the historical, aesthetic, ethnological or anthropological points of view.

Article 2

For the purposes of this Convention, the following shall be considered as "natural heritage":

- Natural features consisting of physical and biological formations or groups of such formations, which are of Outstanding Universal Value from the aesthetic or scientific point of view;
- Geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of Outstanding Universal Value from the point of view of science or conservation;
- Natural sites or precisely delineated natural areas of Outstanding Universal Value from the point of view of science, conservation or natural beauty.

(Baumert N, 2019)

Mixed Cultural and Natural Heritage

Properties shall be considered as "mixed cultural and natural heritage" if they satisfy a part or whole of the definitions of both cultural and natural heritage laid out in Articles 1 and 2 of the Convention. (Baumert N, 2019)

Cultural Landscapes

Cultural landscapes inscribed on the World Heritage List are cultural properties and represent the "combined works of nature and of man" designated in Article 1 of the Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

They should be selected on the basis both of their Outstanding Universal Value and of their representativity in terms of a clearly defined geo-cultural region. They should be selected also for their capacity to illustrate the essential and distinct cultural elements of such regions.

The term "cultural landscape" embraces a diversity of manifestations of the interaction between humankind and the natural environment.

Cultural landscapes often reflect specific techniques of sustainable land use, considering the characteristics and limits of the natural environment they are established in, and may reflect a specific spiritual relationship to nature. Protection of cultural landscapes can contribute to current techniques of sustainable land use and can maintain or enhance natural values in the landscape. The continued existence of traditional forms of land use supports biological diversity in many regions of the world. The protection of traditional cultural landscapes is therefore helpful in maintaining biological diversity.

Types
Cultural landscapes fall into three main types, namely:

- The most easily identifiable is the clearly defined landscape designed and created intentionally by people. This embraces garden and parkland landscapes constructed for aesthetic reasons which are often (but not always) associated with religious or other monumental buildings and ensembles.
- The second type is the organically evolved landscape. This results from an initial social, economic, administrative, and/or religious imperative and has developed its present form by association with and in response to its natural environment. Such landscapes reflect that process of evolution in their form and component features. They fall into two subtypes:
    - » A relict (or fossil) landscape is one in which an evolutionary process came to an end at some time in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form;
    - » A continuing landscape is one which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time;
- The final type is the associative cultural landscape. The inscription of such landscapes on the World Heritage List is justifiable by virtue of the powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.

(Baumert N, 2019)

IPCC (Intergovernmental Panel on Climate Change)

The United Nations body, established in 1988, for assessing the science related to climate change; it was created to provide policymakers with regular scientific assessments on climate change, its implications, and potential future risks, as well as to put forward adaptation and mitigation options. The IPCC is the most authoritative international body on climate science and is an essential component of the world's response to climate change. (Heron & et.al., 2022)

Mitigation (of Climate Change)

A human intervention to reduce emissions or enhance the sinks of greenhouse gases (GHGs). Mitigation measures in climate policy are technologies, processes or practices that contribute to mitigation, for example renewable energy technologies, waste minimisation processes, public transport commuting practices, etc. (Heron & et.al., 2022)

Adaptation

Adaptation refers to adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change. (UNFCCC, 2023)

Weather

The state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity and barometric pressure (WMO, 2011).

In the context of the PIEVC Protocol:
Weather refers, generally, to day-to-day temperature and precipitation activity. Climate refers to average atmospheric conditions over longer periods of time. A weather event are specific atmospheric conditions related to temperature, moisture, wind velocity, and barometric pressure. Within the context of the risk assessment, a weather event is defined by a value for specific atmospheric conditions that could potentially exceed infrastructure threshold values.

A weather forecast is a prediction of individual weather elements on an hourly or on a daily basis. Forecasts are determined from a combination of weather model output, constrained by observed data every 12 hours, and local sources of information such as tracks of storms and precipitation from satellite and radar reports. (Baumert N, 2019)

Climate

Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined

by the World Meteorological Organization. The relevant quantities are most often-surface variables such as, temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

The statistical character of climate has significant consequences on climate information and its usability. The interpretation of climate data (statistics) is very much dependent on the choice of the temporal and spatial scale as well as on the object (variable, indices) of analysis. In the context of Climate Services, temporal and spatial scales as well as the object of analysis for CS-products should be chosen with care and in the context of decision-making. A discussion about the usability of standardized climatological products and the need for specialized products should take place. (Baumert N, 2019)

Micro Climate

The local climate as moderated by geographic or physical features. Large rivers or lakes can affect the local climate. Populated areas tend to see somewhat different weather than the surrounding regions. (Baumert N, 2019)

Climate Change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. (Baumert N, 2019)

Climate Variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). (Baumert N, 2019)

Climate Extreme (Extreme Weather or Climate Event)

Both, extreme weather events and extreme climate events are referred to collectively as 'climate extremes. From this definition, [...] climate extremes can be defined quantitatively in two ways:

- Related to their probability of occurrence
- Related to a specific (possibly impact-related) threshold

Statistically, climate extremes relate to the occurrence of a value of a weather or climate variable above or below a threshold value near the upper or lower ends of the range of observed values of the climatic variable. The distinction between extreme weather events and extreme climate events is not precise, but is related to their specific time scales:

- An extreme weather event is typically associated with changing weather patterns, that is, within periods of less than a day to a few weeks.
- An extreme climate event happens on longer time scales. It can be the accumulation of several (extreme or non-extreme) weather events (e.g., the accumulation of moderately below average rainy days over a season leading to substantially below average cumulated rainfall and drought conditions) (IPCC AR5 – SREX).

Some climate extremes (e.g., droughts, floods) may be the result of an accumulation of moderate weather or climate events (this accumulation being itself extreme). Compound events, that is, two or more events occurring simultaneously, can lead to high impacts, even if the two single events are not extreme per se (only their combination).

Not all extreme weather and climate events necessarily have extreme impacts, It is the vulnerability to these extremes that reveal the degree of impact.

In the context of the PIEVC Protocol:
A climatic condition that the infrastructure could experience deemed relevant for consideration in the vulnerability assessment. This could include normal climatic events considered in the design, development and management of the infrastructure and also recent climatic trends and events that could potentially affect the infrastructure. (Baumert N, 2019)

Climate Data
Historical and real-time climate observations along with direct model outputs covering historical and future periods. Information about how these observations and model outputs were generated ("metadata") should accompany all climate data. (Baumert N, 2019)

Metadata
Information about meteorological and climatological data concerning how and when they were measured, their quality, known problems and other characteristics. (Baumert N, 2019)

Observation
Observation, or observed data, refers to any information that has been directly measured. In climatology, this means measurements of climate variables such as temperature and precipitation. (Baumert N, 2019)

Variable
The name given to measurements such as temperature, precipitation, etc. (climate variables), sea level rise, salinity, etc. (marine variables) and cooling degree-days, days of air frost, etc. (derived variables). (Baumert N, 2019)

Climate Parameter (PIEVC)
A specific set of weather conditions or climate trends deemed to be relevant to the infrastructure under consideration. The parameter may be a single variable, such as mean monthly temperature, or a combination of variables, such as low temperature combined with rainfall. Within the context of a vulnerability assessment, climate parameter selection is tailored to the specific design, operational and maintenance characteristics of the infrastructure being assessed. (Baumert N, 2019)

Essential Climate Variable (ECV)
An ECV is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterization of Earth's climate. ECV datasets provide the empirical evidence needed to understand and predict the evolution of climate, to guide mitigation and adaptation measures, to assess risks and enable attribution of climate events to underlying causes, and to underpin climate services. They are required to support the work of the UNFCCC and the IPCC. (Baumert N, 2019)

Climate Threshold
The point at which external forcing of the climate system, such as the increasing atmospheric concentration of greenhouse gases, triggers a significant climatic or environmental event which is considered unalterable, or recoverable only on very long time-scales, such as widespread bleaching of corals or a collapse of oceanic circulation systems. (Baumert N, 2019)

Return Period
The expected mean time between occurrences that equal or exceed a particular defined, usually extreme or unusual event. Often used to express the frequency of occurrence of the event (= 1/return period). Estimates of return periods are subject to uncertainty, such that consecutive events may occur at intervals greater or smaller than the average return period. (Baumert N, 2019)

Adaptive Capacity
The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. (Heron & et.al., 2022)

Climate Projection
A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. (Heron &

et.al., 2022)

Exposure
A measure of the contact between a system (whether physical or social) and a stressor. (Heron & et.al., 2022)

Sensitivity
The degree to which a system is affected, either adversely or beneficially, by climate variability or change. (Heron & et.al., 2022)

Coral Bleaching
When corals are stressed by changes in conditions such as temperature, light, or nutrients, they expel the symbiotic algae living in their tissues, causing them to turn completely white. (National Ocean Service, 2023)

Saltwater Intrusion
Saltwater intrusion is a natural process that occurs in virtually all coastal aquifers. It consists of salt water (from the sea) flowing inland in freshwater aquifers. This behavior is caused by the fact that sea water has a higher density (which is because it carries more solutes) than freshwater. This higher density has the effect that the pressure beneath a column of saltwater is larger than that beneath a column of the same height of freshwater. If these columns were connected at the bottom, then the pressure difference would trigger a flow from the saltwater column to the freshwater column. (European Environment Agency, n.d.)

Permafrost
Permafrost is a permanently frozen layer below Earth's surface. It consists of soil, gravel, and sand, usually bound together by ice. (National Geographic, 2023)

Permafrost Degradation
Permafrost degradation refers to a naturally or artificially caused decrease in the thickness and/or areal extent of permafrost. (Intergovernmental Panel on Climate Change, 2007)

Desertification
Desertification refers to land degradation in arid, semi-arid and dry sub humid areas resulting from various factors, including climatic variations and human activities (UNCCD, 2017).

El Niño - Southern Oscillation (ENSO) Phenomenon
El Niño and the Southern Oscillation, also known as ENSO, is a periodic fluctuation in sea surface temperature (El Niño) and the air pressure of the overlying atmosphere (Southern Oscillation) across the equatorial Pacific Ocean. (National Center for Environmental Information, n.d.)

Soil erosion and Degradation
Soil erosion is defined as the accelerated removal of topsoil from the land surface through water, wind and tillage (FAO, 2020).

Soil degradation is defined as a change in soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries. (FAO Soils Portal, 2020)

Landslide
The term "landslide" refers to a variety of processes that result in the downward and outward movement of slope-forming materials, including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. (UNISDR, 2017)

Seismicity/ Earthquake
Earthquakes can strike suddenly and without warning. An earthquake is a violent and abrupt shaking of the ground, caused by movement between tectonic plates along a fault line in the earth's crust. Earthquakes can result in the ground shaking, soil liquefaction, landslides, fissures, avalanches, fires and tsunamis. (World Health Organization, n.d.)

Resilience
The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and

recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. (UNDRR, 2016)

Vulnerability

The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. (UNDRR, 2016)

Annexure 1

Summary of the Webinar Titled 'Climate Action, Built and Cultural Heritage in Indian Cities'

The 'Climate Action for Built and Cultural Heritage in Indian Cities' project is being undertaken by a consortium of three organizations, with Cultural Resource Conservation Initiative (CRCI) India Pvt. Ltd. as the lead along with Center for Heritage Conservation, CEPT Research and Development Foundation (CHC, CRDF) and Urban Design Collective (UDC) as the project partners. The project is under the aegis of NIUA and is being funded through the same networks as CITIIS, i.e. Agence Française de Développement (AFD) and the European Union (EU). A meeting and webinar were organized on 25th and 26th August 2023 as part of the project, to engage with domain experts. The meeting on 25th August was held in Surat, while presentations and discussions during a webinar took place online on 26th August, with various experts from the field of urban planning, architecture, heritage conservation, climate change, disaster risk, building science and energy, landscape, structural engineering etc.

Meeting on 25th August 2023 at Surat

The meeting started with an introductory presentation by Uttra Dasgupta, the Knowledge Officer in the CITIIS program, introducing the City Investments to Innovate, Integrate and Sustain (CITIIS) Program. CITIIS It is a collaborative effort of the Ministry of Housing and Urban Affairs, the French Development Agency and the European Union. Managed by the National Institute of Urban Affairs (NIUA), the program focuses on sustainable urban development in 12 cities. The speaker explained the methodology used to design the CITIIS program. One unique aspect of the process is the Maturation Phase, a 24-step project development process, to ensure the preparedness of the selected cities. She explained that the program not only assists cities, but also captures and disseminates knowledge through various ways like guidelines and toolkits. Recognizing India's diverse geographical and climatic conditions, CITIIS aims to explore the potential of cultural heritage in addressing climate change. This ambition is considered in the 'Climate Action, Built and Cultural Heritage in Indian Cities' project. The program intends to contribute to culture-based responses to climate change aligned with sustainable development goals.

The next lecture was delivered by Dr. Neelima Jerath who is the Director General at Pushpa Gujral Science City (Punjab) and Member Expert Committee at National Biodiversity Authority. She gave a comprehensive presentation on 'National Government Framework for State Action Plans for Climate Change'. The speaker discussed the major concern of carbon's role in climate change, with emphasis on the UN Framework Convention for Climate Change (UNFCCC) and India's National Climate Change Program. Dr. Jerath talked about India's global ranking in greenhouse gas emissions and the complexities of per capita emissions. The UN Sustainable Development Goals (SDGs) are woven into the narrative, highlighting India's position and the need for sustainability. The presentation delved into state-level climate action plans, with a spotlight on Punjab state's efforts. The impacts of urbanization on climate change and vice versa were explored, encompassing health, environment and economic considerations. India's commitments in international conventions, for example in the Paris Agreement which include ambitious targets for emission reduction and renewable energy adoption, were discussed in detail. The speaker highlighted opportunities for leveraging green donor funds, carbon credit programs, and biodiversity initiatives. The concluding emphasis was on the potential for nature-based solutions in urban areas, philanthropic contributions and emerging government programs such as the green credit program and city biodiversity index. Overall, the speaker emphasized the inter-connectedness of climate action, sustainable development and the need for varied collaborative strategies.

The next presentation was made by the Project Lead and Director of CRCI (India) Pvt Ltd Gurmeet Rai. She

discussed learnings from the HRIDAY Program based on her experience. She emphasized the need to apply a climate lens to heritage projects within the Indian context. In the year 2015, the Ministry of Housing and Urban Development engaged with historic cities through the HRIDAY (Heritage City Development and Augmentation Yojana) program, which focused on 12 pilgrimage cities. The HRIDAY project involved city anchors, consultants and institutions to map cultural heritage, identify heritage zones and develop city HRIDAY plans. The plans included the protection and enhancement of heritage values, cultures and toolkits for the same. The speaker presented detailed cases of strategies devised for Puri and Amritsar, showcasing the identification of heritage zones, gap analysis and proposed interventions. The importance of community engagement and aligning solutions with local cultural traditions was highlighted. The speaker described the proposed designs for improving mobility, stormwater management and preparing guidelines for historic structures. She urged for an integrated approach, stressing the need for the city HRIDAY plan to be part of the mainstream planning process and involving interdepartmental dialogue. Capacity building for urban local bodies, effective communication, participatory processes, stakeholder mapping and risk preparedness were emphasized for sustainable development. The presentation concluded by underlining the relevance of aligning projects with Sustainable Development Goals (SDGs) and adopting a climate lens for future urban development.

The following presentation was made by Prof. Jigna Desai, Project Partner and Head of Center for Heritage Conservation, CEPT Research and Development Foundation (CHC, CRDF). She provided an overview of the intersections of climate change and cultural heritage and the need for strategies for climate action within it. She then presented the overall framework of the project 'Climate Action, Built and Cultural Heritage in Indian Cities', the methodology of which derives from learning through existing frameworks and cases studies of good practices. The existing frameworks include an examination of – international frameworks, toolkits and recommendations; national, state and city level climate action plans; and programs or frameworks such as HRIDAY, CITIIS and World Heritage Cities. The cases studies of good practices include international, examples, national examples and again examples drawn from programs or frameworks such as HRIDAY, CITIIS and World Heritage Cities. She presented the preliminary scoping matrix of historic cities in India prepared by the team and the subsequent phases which would include in-person workshops in selected cities, the development of a draft framework and toolkit and the creation of e-learning modules for capacity building. The presentation also hinted at challenges such as, social hierarchies and economic feasibility when considering cultural heritage as a resource for climate action.

Webinar on 26th August 2023

The webinar started an introductory presentation by Utrra Dasgupta, gain explaining the CITIIS program for the new audience. This was followed by a presentation by Gurmeet Rai. She started her presentation with a a video on CO2 emission of different countries and their positioning, highlighting the need for urgent action needed for comprehensive climate action in Indian cities. She then gave an overview of the project 'Climate Action, Built and Cultural Heritage' for the new audience. The presentation underscored the importance of understanding regional variations of heritage, materiality of heritage and collaborative partnerships for climate action. She highlighted that by aligning with existing national initiatives and learning from international case studies, the project aims to create a comprehensive framework for climate action in heritage-rich cities, contributing to both mitigation and adaptation efforts. The ultimate aim is to bridge gaps, inform strategies and build resilience, fostering a holistic approach to climate change in the context of cultural heritage in India, especially in urban environments.

Keynote

The keynote address was by Ms. Vaishali Nandan, Head of Projects "Cities Combatting Plastics entering Marine Environment", "Management of Organic Waste in India" and "UrbanACT-India' and Climate Smart Cities, at GIZ in India. Ms. Nandan being associated with Climate Smart Cities at GIZ, discussed their work in developing strategies for climate action in selected Indian cities. GIZ supports several countries globally, with a focus on green and sustainable development in India. She discussed their involvement in urban development, particularly through projects like the Climate Smart Cities Project, now being taken up by the integrated Urban Climate Action and Low Carbon & Resilient Cities Project (UrbanACT). The speaker highlighted interventions in five Indian cities, Bhubaneshwar, Kochi, Coimbatore, Panaji and Shimla addressing issues like urban flooding, vegetation loss and unorganized built-up areas. Strategies for sustainable urban development and climate response included preparing digital solutions, preparing drainage master plans, addressing construction and

demolition waste management, adopting green building practices and mapping heat islands to prepare baseline data. The presentation underlined the significance of community involvement, citing instances where citizens, NGOs and municipal corporations collaborated on solutions. The keynote concluded by stressing the importance of capacity building for relevant stakeholders and highlighted tools like the Climate Smart Cities Assessment framework and the Climate Alliance to facilitate informed urban development.

Session 1

The first presentation of Session 1 was by Dr. Will Megarry, the Focal Point for ICOMOS Climate Action Working Group. He discussed the organization's efforts in addressing climate change through various initiatives. This presentation was a pre-recorded session as Dr. Megarry was not able to join the webinar. Founded in 2006, as the Climate Change and Heritage Working Group, the group's primary tasks included contributing to the update of the 2007 policy document on climate change impacts on World Heritage properties and developing global climate change organizational strategies. Significant initiatives and events mentioned in his presentation were the 'The Future of Our Past: Engaging Cultural Heritage in Climate Action' report of ICOMOS, the 'Heritage on the Edge' project, the international co-sponsoring meeting on Culture, Heritage and Climate of December 2021, CVI Africa Project, Preserving Legacy Project and other ICOMOS toolkits.

Dr. Megarry explained that 'The Future of Our Past' report, published by ICOMOS in 2018, mapped intersections between culture and climate. The 'Heritage on the Edge' project aimed to communicate the impacts of climate change on iconic heritage sites. The international co-sponsoring meeting on Culture, Heritage and Climate in December 2021 brought together scholars, scientists and heritage custodians to bridge the gaps between climate science and cultural heritage. This event resulted in the Global Research and Action Agenda on Culture, Heritage and Climate Change. The discussion then shifted to heritage tools and methodologies. Dr. Megarry highlighted the uncertainty surrounding climate change impacts on heritage and introduced the Climate Vulnerability Index Africa Project, where the CVI (C for Virtual Instrumentation) tool was applied in an African context. He also mentioned the ongoing Preserving Legacy Project, funded by the National Geographic Society, aiming to empower communities globally with knowledge and training for adaptation planning.

The presentation concluded with an overview of efforts to increase capacity and provide resources for the heritage sector. Two toolkits on climate justice & equity and climate change adaptation have been produced, accompanied by workshops translated into multiple languages. Plan for a comprehensive climate action website is also in progress. Throughout the presentation, he emphasized the importance of addressing climate change in the heritage sector and underlines ICOMOS's commitment to fostering collaboration and sharing resources globally.

The second presentation in Session 2, was made by Mr. Vishwanath Srikantaiah, Founder and Director, Biome Environmental Solutions Pvt. Ltd. on 'Tanks and Wells - Water Solutions for Climate Change from a Cultural Heritage Perspective in the City of Bengaluru'. In his presentation, he talked about the multifaceted impacts of climate change, particularly focusing on cultural and built heritage, livelihoods, and their intricate interactions. Titled 'Kere-Baavi', the lecture first provided an overall picture of the climate crisis and the need for urgent action. Emphasizing the loss of water in once-vibrant bodies like Agrasen ki Baoli, he highlighted the need for maintaining the significance of water related heritage sites, not only the skeletal aspects but also the functional aspects.

Presenting the history of the region of Bangalore and its surrounding areas, he explained its rich geological history of 3400 million years, leading to the creation of a landscape of interconnected tanks and wells. The tank ecosystem, rooted in ancient practices, involves catchments, dams and intricate social systems for water distribution. The talk proceeded to explain the impact of urbanization on these landscapes, narrating the historical shift from tank reliance to piped water supply. The emergence of bore wells further alters traditional livelihoods, affecting communities that were once reliant on these ecosystems for their lives and livelihoods. The speaker presented the interventions and work of Biome Trust to rejuvenate the ecosystem of these water-related practices, linking heritage preservation with livelihoods.

After establishing the interlinkage of the larger landscape and the specific water structures such as wells and tanks, Vishwanath explained the water consumption patterns in urban areas and their relationship to the hinterland. He presented innovative solutions for rainwater harvesting and wastewater management,

to not only address urban water needs but also to mitigate climate impacts. The presentation concluded by advocating for a holistic approach, blending tradition with modern technologies. It emphasized the need for community involvement, gender and caste-based inclusivity and the importance of adaptive, decentralized solutions for sustainable water management.

The third presentation was by Mr. Mohan Rao, Landscape Architect, Principal Designer, Integrated Design (INDÉ). The presentation emphasized the interconnectedness of ecological systems, from drinking water to everyday spaces in villages and cities. He highlighted the need to move beyond binary views and recognize the continuous dynamic relationship between environment, heritage and development. The narrative proceeded into specific cases, such as the Sudarbans and Vijayanagara, highlighting the symbiotic interaction between humans and landscapes. It emphasized the need to protect landscapes not just as museum artifacts but as living entities with intrinsic functions. The presentation focused on contemporary challenges, illustrating how traditional systems offer answers which are locally rooted solutions. Cases from Hampi, Puri and Hathigaon explained the rejuvenation of landscapes, aligning them with cultural, ecological and practical necessities.

Furthermore, the presentation provided glimpses into contrasting landscapes like the Malaprabha Valley, Meghalaya and the Sone River in Bihar. These cases showcased diverse interventions, ranging from textile traditions to water management, each deeply connected to the unique characteristics of its site. The emphasis throughout was on context-specific strategies embedded in traditional knowledge systems. The speaker advocated for an approach that embraces the inherent characteristics of landscapes, understanding them as intricate, interwoven systems rather than as static entities. The request for action indicated the idea that sustainable solutions come from recognizing and embracing the profound relationship between cultural heritage, environmental wisdom and contemporary challenges.

The three presentations were followed by a panel discussion amongst the speakers and two other invited experts, Ms. Prathijna Poonacha, Senior Consultant at Indian Institute for Human Settlements (IIHS) and Prof. Subhrangsu Goswami, Environmental Planner and Environmental Engineer, Assistant Provost (Academics) at CEPT University. Ms. Prathijna Poonacha, built on the presentations of the session and reflected on what the IPCC has been emphasising.

She mentioned that the assessment report six that concluded earlier in 2023 emphasises the idea of coupled systems, such as natural and human systems within climate systems. She reflected that both Vishwanath and Rao's presentations highlighted this aspect through examples. The idea of climate resilient development is the bringing together of sustainable development goals, the idea of climate mitigation and adaptation into a common framework to think about development pathways and these ideas got demonstrated in the speakers' examples. She also highlighted that the idea of decentralised systems, which both the speakers presented is becoming more relevant in urban areas in terms of resource management, multiplicity of institutions and governance mechanisms. She mentioned that the scale of city action plans is what could be very relevant in terms operationalizing climate action as this is the space where one could really work with questions such as how to deal with cultural heritage of everyday heritage practices, monuments and local heritage.

Prof. Subhrangsu Goswami mentioned that the issue of climate change is running faster than the solutions and therefore it is very important to present encouraging success stories. He highlighted that when the problems are complex and interlinked, stand-alone solutions are not enough. A framework for comprehensive solution-building is necessary. He talked about two tools, the tool of urban planning within the urban context and that of Environmental Impact Assessment (EIA). These tools need to be utilised effectively and integrated with issues of climate change for comprehensive solutions at the larger scale.

Further discussions included themes of strengths and weaknesses of community-led and top-down frameworks of operation, embedded traditional knowledge systems and their effective use and the need to be able to address the issue of climate change through multiple paths and methods for effective solution-building.

Session 2

Session 2 began with a presentation by Prof. Rajan Rawal, Senior Advisor, Center for Advanced Research in Building Science and Energy (CARBSE), CEPT Research and Development Foundation (CRDF) on climate responsive vernacular houses, specifically a study of Pol houses of Ahmedabad which was conducted in the

year 2017-18. The focus was on how traditional pol houses adapt to climate change. He discussed the specifics of climate change in Ahmedabad such as rising temperatures, heat waves and urban heat island effect. He highlighted the challenges of managing rapid urbanization and the need for comprehensive solutions in urban planning. In a more detailed study, he discussed thermal comfort, adaptive comfort models and the performance of traditional pol houses compared to contemporary ones. He concluded stating the need for a science-based understanding of traditional architecture and presented findings related to temperature adaptation and moisture buffering capacity.

The next presentation in the session was by Dr. Sanjay Chikermane, Assistant Professor at the Department of Civil Engineering, IIT Roorkee. He presented a project which was started as an inquiry into the Kath-Kuni houses in the Indian Himalayas, renowned for their resilience to seismic activities. He mentioned that previous architectural studies on such houses have existed, although a direct structural examination have been lacking, therefore this study was initiated. He presented the process of scientific analysis of the traditional construction system and the process of designing an innovative reinterpretation of the vernacular construction and structural system, such that the houses can adapt to the issue of excessive consumption of wood as a building resource.

The speaker also highlighted the extensive use of deodar wood in the traditional construction system. Seeking a balance between tradition and modern challenges, a reinterpreted system was developed, reducing wood usage by 25 to 30% through innovative wood-to-wood connections and introducing steel elements. This system displayed impressive structural behaviour. Beyond theoretical exploration, and prototype testing, the team applied the reinterpreted system to retrofit damaged walls in a house in the region. The results demonstrated the effectiveness of the retrofit positioning retrofitting old buildings as a viable solution to resource issues and meet contemporary aspirations and need.

The last presentation of this session was made by Ms. Aparna Tandon, Senior Programme Leader for First Aid and Resilience for Cultural Heritage in Times of Crisis (FAR) at ICCROM and Mr. Repaul Kanji, a disaster risk management professional. Aparna presented an overview of ICCROM's project titled 'Net Zero Heritage for Climate Action' and its five innovation sites in Brazil, Egypt, India and Uganda. Repaul Kanji presented the specific innovation site selected in India, that of Jodhpur.

Ms. Tandon highlighted the recent climate warnings, global disasters and the urgent need for sustainable practices. She posed questions on the role of heritage bodies in addressing climate crises and how heritage knowledge can contribute to climate solutions. She introduced ICCROM's program, which intersects disasters, conflicts and climate crises. She shared insights from the 'Climate Culture Peace' conference, focusing on the interdependence of natural and cultural environments. The speaker advocated for the development of new conceptual frameworks for heritage that take into account of both physical structures and the knowledge to live sustainably. She critiqued top-down approaches and emphasized the importance of local capacity and place-specific knowledge. Ms. Tandon illustrated the practical application of these ideas in the project 'Net Zero Heritage for Climate Action.' Using case studies like Rosetta in Egypt, she explained the program's focus on retaining land, protecting heritage and incorporating indigenous knowledge. Aparna talked about the project HAYA in Egypt, which aimed to revive traditional practices, combat soil salinity and foster intergenerational transmission of knowledge. She touched upon the other innovation sites, where similar community-based solutions and approaches are being designed.

Mr. Kanji discussed the proposal and the current stage of the project at Jodhpur. He presented the planned phases of the project and the work done so far. In his presentation, he framed the city of Jodhpur's evolution as a journey from resilience to fragility. The aim of the innovation project at Jodhpur is to mainstream place-based knowledge and traditional practices into a policy, specifically by preparing a Heat Action Plan for the city. The Initial phase involved extensive research merging climate science with local insights. Stakeholder consultations and workshops with women and children revealed the unique roles they play in preserving culture and influencing climate action. Mr. Kanji emphasized the importance of tapping into culture as a long-term strategy to combat climate change. The speaker concluded by outlining future steps, including a documentary on Jodhpur's climate story, an architectural study, efforts to revive water culture and disseminating lessons on culturally sensitive urban development.

The three presentations were again followed by a panel discussion amongst the speakers and two other invited experts, Ms. Shalini Dasgupta, ICOMOS India Focal Point for the Climate Change and Heritage Working

Group and Mr. Gaurav Shorey, Director at Psi Energy Pvt. Ltd. Ms. Shalini Dasgupta gave an introduction to ICOMOS India's Climate change and Heritage Working Group. Reflecting on the presentations in the session she mentioned that there is a three-way interaction between climate change, energy efficiency and thermal comfort and it is very important to understand this inter-relationship in the case of conservation of heritage buildings and devise ways of low-energy and cost-effective adaptive re-use solutions. Reinterpreting historic systems as presented in one of the presentations is also an important point for this. She also highlighted the need for standards and guidelines to assess and plan for thermal comfort for heritage buildings.

Mr. Gaurav Shorey reflected that with the kind of diversity in Indian traditional knowledges across the country's geographical landscape, a detailed study and understanding of the 'local' is very important. He emphasized the importance of systemic understanding of the entire local ecology and the need for inter-generational knowledge transfer.

Further discussions in the panel included discussions on the need for more studies for a systematic understanding of climate performance of heritage buildings along with the immediate need to connect climate science with community-based knowledge for climate action. An understanding of lived experience and landscapes is vital to identify the tipping point from resilience to vulnerability and devise ways in which communities can be directed towards resilience.

Concluding Notes

The concluding session of the seminar included notes from Diane Bittar from the French Development Agency in New Delhi, the agency funding the Climate Action, Built and Cultural Heritage in Indian Cities', a summary of the methodology of collecting case studies for this project by Project Partnaer, Vidhya Mohankumar and a questions and answers session with the audience.

Diane Bittar addressed the importance of heritage preservation within the realm of development. She emphasized heritage as a shared collective legacy and a potent tool for economic development, intercultural dialogue and religious harmony. She mentioned that the French Development Agency, active in heritage sectors globally, has forged long-term relationships, particularly in countries like Tunisia and Pakistan. In India, their focus on urban development aligns with addressing the challenges of climate change, collaborating with the National Institute of Urban Affairs (NIUA) in the CITIIS program, supporting the 12 cities. Diane highlighted that heritage is integral for projects in cities like Ujjain, Dehradun and Bhubaneshwar. The agency recognizes India's rich architectural heritage, aiming to raise awareness through initiatives like the Climate and Heritage study, supported by the European Union. The study intends to identify challenges faced by historical cities in India and align them with ongoing projects.

Vidhya Mohan Kumar then elaborated the framework of case studies. She highlighted that eventually, the framework aims to extract key learnings and practical applications from the case studies and experiences of different cities. She elaborated on the content within each section and discussed how the framework incorporates a diverse range of aspects, from climate hazards and impacts to mitigation measures and financial aspects. This comprehensive framework aims to provide a structured approach to understanding the complexities of climate change, climate action and their impact on cultural heritage in various cities.

Dr. Jigna Desai concluded the webinar through a questions and answers session. She emphasized the importance of studying and understanding the complex relationship between climate, climate science, heritage and traditional knowledge. She mentioned the awareness of the challenges in simplifying complex discussions into frameworks and toolkits. However, she highlighted that this seminar deeply informed the ongoing journey of the project, refined the questions and highlighted the need for constant discussions and feedback loops to address the nuanced knowledge at the intersection of culture, heritage and climate change.

Meeting and Webinar Schedule

Day 1

25th August 2023, Friday, 2.00 pm to 4.15 pm; Venue: Surat

02:00 pm	**Introduction to the Project: Climate Action, Built and Cultural Heritage in Indian Cities** **Ms. Akanksha Laroiya** Senior Program Officer CITIIS-NIUA
02:10 pm	**National Government Framework for State Action Plans for Climate Change** **Dr. Neelima Jerath** Director General, Pushpa Gujral Science City Member, Expert Committee, National Biodiversity Authority
02:30 pm	**Learnings from HRIDAY Program** **Ms. Gurmeet Rai** Project Lead, Climate Action, Built and Cultural Heritage in Indian Cities Director, CRCI (India) Pvt Ltd
02:50 pm	**CITIIS Knowledge Products** **Ms. Uttara Dasgupta** Knowledge Officer- CITIIS Program, NIUA
03:10 pm	**Project Outline, Roadmap and Methodology** **Prof. Jigna Desai** Project Partner, Climate Action, Built and Cultural Heritage in Indian Cities Center Head, CHC, CRDF
03:30 pm	**Discussion and Open House**
04.00 pm	**Closing Remarks** **Ms. Gurmeet Rai** Project Lead, Climate Action, Built and Cultural Heritage in Indian Cities Director, CRCI (India) Pvt Ltd

Day 2

26th August, Saturday, 9.30 am to 5.00 pm, Online, Open to all

Introduction and Keynotes: 9.30 am to 11:00 am **Moderated by Prof. Jigna Desai** Project Partner, Climate Action, Built and Cultural Heritage in Indian Cities Center Head, CHC, CRDF	
09:30 am	**Welcome Note** **Prof. Jigna Desai**
09:40 am	**Introduction to NIUA and its Initiatives** **Mr. Uttra Dasgupta** Knowledge Officer – CITIIS Program, NIUA
10:00 am	**Introduction to the Project: Climate Action, Built and Cultural Heritage in Indian Cities** **Ms. Gurmeet Rai** Project Lead in Climate Action, Built and Cultural Heritage in Indian Cities Director, CRCI (India) Pvt Ltd
10:30 am	**Keynote** **Ms. Vaishali Nandan** Project Head, Cities Combatting Plastics Entering Marine Environment (CCP-ME); Management of Organic Waste in India (MoWI); UrbanACT-India (Integrated Urban Climate Action for Low carbon & Resilient cities); Climate Smart Cities Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH India
11:00 am	**Break**

Session 1: 11:15 to 1:15 pm **Moderated by Ms. Jayashree Bardhan,** Lead Researcher in Climate Action, Built and Cultural Heritage in Indian Cities Program Lead - Assessment and Training, CHC, CRDF	
11:15 am	**Culture, Climate and Action – The Activities of the ICOMOS Climate Action Working Group** **Dr. Will Megarry** Focal Point, ICOMOS Climate Action Working Group
11:45 am	**Tanks and Wells - Water solutions for climate change from a cultural heritage perspective in the city of Bengaluru** **Mr. Vishwanath Srikantaiah** Founder and Director, Biome Environmental Solutions
12:15 pm	**Tentative Topic: Water Management and Conservation Strategies** **Mr. Mohan Rao** Landscape Architect, Principal Designer, Integrated Design (INDÉ)
12:45 pm	**Panel Discussion I Q&A** Discussants: **Ms. Prathijna Poonacha Kodira,** Senior Consultant , Indian Institute for Human Settlements(IIHS) **Prof. Subhrangsu Goswami,** Environmental Planner and Environmental Engineer, Assistant Provost (Academics), CEPT University
01:15 pm	**Break**
Session 2: 2.15 pm to 4.15 pm **Moderated by Ms. Jayashree Bardhan,** Lead Researcher in Climate Action, Built and Cultural Heritage in Indian Cities Program Lead - Assessment and Training, CHC, CRDF	
02:15 pm	**Climate Responsive Vernacular Houses, A Study of Pol Houses of Ahmedabad** **Prof. Rajan Rawal** Senior Advisor, Center for Advanced Research in Building Science and Energy (CARBSE), CEPT Research and Development Foundation (CRDF).
02:45 pm	**Tentative Topic: Resource Conscious Adaptation of Built Heritage in Uttarakhand** **Dr. Sanjay Chikermane** Assistant Professor, Department of Civil Engineering, IIT Roorkee
03:15 pm	**ICCROM's Project - Net Zero: Heritage for Climate Action** **Ms. Aparna Tandon,** Senior Programme Leader, First Aid and Resilience for Cultural Heritage in Times of Crisis, ICCROM **Mr. Repaul Kanji,** Disaster Risk Management Professional
03:45 pm	**Panel Discussion I Q&A** Discussants: **Ms. Shalini Dasgupta** ICOMOS India Focal Point for the Climate Change and Heritage Working Group **Mr. Gaurav Shorey** Director – Psi Energy Pvt. Ltd. , GRIHA Trainer and Technical Advisory Committee Member
Concluding Notes: 4:15 pm to 5:00 pm	
04:15 pm	**Notes from AFD** **Ms. Diane Bittar** Sector Portfolio Manager - Urban Development Agence Française De Développement
04:30 pm	**Discussion on Case Study Framework** **Ms. Vidhya Mohankumar** Project Partner in Climate Action, Built and Cultural Heritage in Indian Cities Founder and Principal, UDC
04:45 pm	**Summarising Discussions and Way Forward** **Prof. Jigna Desai** Project Partner in Climate Action, Built and Cultural Heritage in Indian Cities Center Head, CHC, CRDF

Organizations, Team and Speakers' Profile

Team

Ms. Gurmeet S. Rai
Founder and Director, Cultural Resource Conservation Initiative (CRCI) India Pvt. Ltd.

Gurmeet S. Rai is a New Delhi-based conservation architect. She graduated from Chandigarh College of Architecture and pursued a master's in architectural conservation from SPA Delhi. Early in her career, she worked in the architectural heritage department of INTACH, gaining insights into the challenges of conservation in India. In 1996, she founded Cultural Resource Conservation Initiative (CRCI) India Pvt. Ltd., a consultancy specialising in cultural heritage conservation and management. CRCI's diverse projects encompass architectural documentation, historic building conservation planning, cultural heritage tourism, capacity building, and training. Their clientele includes government bodies, private foundations, UNESCO, Asian Development Bank and others. Gurmeet's notable projects include site management plans for Red Fort and Ellora Caves, management plans for Gobindgarh Fort, urban conservation strategies for Amritsar and Puri, conservation and urban regeneration in Kashmir, and collaboration on international projects like the visitor management plan for Lumbini, Nepal, and UNESCO's Cultural Heritage Policy for Punjab.

Prof. Jigna Desai
Center Head and Principal Researcher, Center for Heritage Conservation (CHC), CEPT Research and Development Foundation (CRDF)

Jigna Desai brings to her institute her experience in working with traditional urban environments and framing how traditional architecture may be understood, studied and transformed. Her current focus involves developing frameworks, tools, and methods to translate theoretical concepts of sustainability and conservation into practical applications while addressing the challenges of co-production of space and commodification of heritage. Jigna played a pivotal role in preparing the dossier that led to the inscription of Ahmedabad into UNESCO's World Heritage List in 2017. An advocate for community-based conservation, she has extensive experience in conservation research and collaborates with national and international institutions on initiatives across India. Jigna is a member of ICOMOS India, expert member of the ICOMOS' International Scientific Committee on Historic Towns and Villages, and director of JMA Design Co, that she co-founded in 1999. She holds a master's degree in sustainable architecture from Cardiff University and a PhD in conservation studies from CEPT University.

Ms. Jayashree Bardhan
Program Lead - Assessment and Training, Center for Heritage Conservation (CHC), CEPT Research and Development Foundation (CRDF)

Jayashree Bardhan holds a master's degree in world heritage studies from BTU, Germany and a bachelor's degree in architecture from CEPT University. She has extensive work experience in architectural projects in urban and rural settings along with cultural heritage mapping and assessment projects. In 2020, she received a research grant from ICOMOS International to investigate the 'Heritage at Risk' sector. Her master's thesis titled, 'Optimising ICOMOS' Heritage at Risk Initiatives: Towards a Comprehensive Framework for Cultural Heritage at Risk' was conducted through collaboration of ICOMOS' International Board and BTU, Germany. Through her master's studies, she gained experience of heritage sites in Germany, Poland and Bahrain. Jayashree is a member of ICOMOS and an associate member of ICORP. She is currently a Visiting Faculty at the Master's Program in Conservation and Regeneration at CEPT, teaching heritage-led urban regeneration focused on people-centred approaches. At CHC, she leads heritage assessments and capacity building programs.

Ms. Vidhya Mohankumar
Founder and Principal, Urban Design Collective (UDC)

Vidhya Mohankumar, an architect and urban designer with 18 years of global experience, is dedicated to creating people-centric cities with a focus on transit for sustainable development. Grounded in intersectional research, her work spans master plans for cities, towns, and various areas, including redevelopment plans for town centers and brownfield sites. Serving diverse clients from state governments to NGOs, her projects encompass strategic planning, regional plans, local area plans, campus master plans, and urban design studies worldwide. Appointed as a technical expert by the National Institute of Urban Affairs in 2019, she mentored Smart City Projects in Hubli-Dharwad and Agartala. A passionate advocate for sustainable development, Vidhya has been a guest faculty at Indian universities for over a decade. She holds a distinguished master's degree in urban design from the University of Michigan and a bachelor's degree in architecture from the National Institute of Technology, Tiruchirapalli, India.

Research Associates

Parvati Poduval (June- 2023 to August- 2023)
Conservation Architect

Vaibhavi Bhojkar (From September- 2023)
Conservation Professional

Vidisha Purohit (From September- 2023)
Conservation Architect

Sharmi. Ra (September - 2023)
Architect & Urban Designer

Gouthaman Ekambaram (September - 2023)
Architect & Urban Designer

Speakers

Dr. Neelima Jerath
Director General, Pushpa Gujral Science City (Punjab), Member Expert Committee, National Biodiversity Authority

Neelima Jerath, current Director General of Pushpa Gujral Science City, holds a Ph.D. in botany and a diploma in management. She served as Executive Director of Punjab State Council for Science & Technology and played pivotal roles in various committees related to environmental clearance and biodiversity. Dr. Jerath's achievements include setting up key initiatives like the Punjab Climate Change Knowledge Centre and Patent Information Centre. Dr. Jerath has also worked as Asia Nodal Officer for two UNESCO's multi-country projects and has participated as EE Expert in various fora at Spain, Germany, Japan, China, USSR, etc. She provides advisory services to the Department of Water Supply and Sanitation, Government of Punjab, and collaborates with UNDP. Recognized for her contributions, she received awards such as the Punjab State Government Award and the 'Award of Honour for Environment Education and Awareness.'

Ms. Uttra Dasgupta
Knowledge Officer, City Investments To Innovate Integrate and Sustain (CITIIS), National Institute of Urban Affairs (NIUA)

Uttra Dasgupta has worked in the domains of culture-led development, urban conservation and revitalization, infrastructure development with various central, state and ULB level government authorities/ agencies/

departments across the country. She carries rich experience in master planning and design, project appraisal, strategy formulation, feasibility studies, policy formulation and evaluation, project implementation, program management. She has a bachelor's degree in architecture from Deenbandhu Chhotu Ram University of Science and Technology, Murthal and master's degree in urban and regional planning, with a specialization in housing from CEPT University. She has attended the international study abroad program at Detmolder Shule fur Architektur und Innerarchitektur, HS-OWL, University of Applied Sciences, Germany.

Ms. Vaishali Nandan
Climate Smart Cities, The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Vaishali Nandan is Head of Projects "Cities Combatting Plastics entering Marine Environment", "Management of Organic Waste in India" and "UrbanACT-India' and Climate Smart Cities, at GIZ in India. She has over 25 years of experience in issues related to waste management (municipal solid waste, construction & demolition waste, plastic waste), urban planning and climate change (stormwater management, green cover, green buildings). A Geographer and Urban Planner by profession, she has several papers to her credit and has been part of several expert committees.

Dr. Will Megarry
Focal Point, ICOMOS Climate Action Working Group

Will Megarry is a member of ICOMOS Ireland, an archaeologist and a senior lecturer at the School of Natural and Built Environment at Queen's University Belfast. His research explores the intersection between culture and climate change, with a particular focus on understanding climate risk and climate communication. He is the Principal Investigator of ICOMOS Climate Action Working Group's CVI-Africa project, funded by the UK Government, one of the lead authors of the 2019 ICOMOS report 'The Future of Our Past: Engaging Cultural Heritage in Climate Action' and has coordinated ICOMOS' engagement in the 'Heritage on the Edge' project.

Mr. Vishwanath Srikantaiah
Founder and Director, Biome Environmental Solutions Pvt. Ltd.

S. Vishwanath is a Civil Engineer and Urban Planner with 36 years of experience in the water, waste- water and sanitation sector helping design rainwater harvesting, aquifer recharge, wastewater recycling and ecosan systems. He is the founder of Rainwater Club, Director of Biome Environmental Solutions, and Trustee of Biome Environmental Trust. He is a member of the Sustainable Sanitation Alliance and the International Water Association. He has been a member of various expert committees which helped formulate the rainwater harvesting policy and law for Bengaluru, the waste-water policy for Karnataka and the water policy for Karnataka, drafted by the Karnataka Knowledge Commission.

Mr. Mohan Rao
Landscape Architect, Principal Designer, Integrated Design (INDÉ)

Mohan Rao is an Environmental Design and Landscape Architecture professional and a partner at Integrated Design (INDÉ), a research-based practice engaged in environmental design, regional planning and landscape architecture with a strong focus on sustainable practices. His areas of engagement include ecosystem services, climate change and passive design; low impact development, heritage site interpretation & traditional knowledge systems. He is passionate about interpreting traditional knowledge systems to help address contemporary challenges in environment and development, specifically focused on the global south. His academic, research and practice initiatives are spread across India, China, Africa, Europe and Latin America. Honours include several awards including those instituted by UNESCO, IFLA, HUDCO, etc.

Ms. Prathijna Poonacha
Senior Consultant, Indian Institute for Human Settlements (IIHS)

Prathijna Poonacha Kodira is a researcher and practitioner who works on climate change adaptation focusing broadly on how social and environmental systems respond to impacts of climate change, especially in urban and peri-urban geographies. Specifically, her work looks at livelihood transitions, nature-based solutions for adaptation and the intersection of climate change and the built environment. At IIHS, she has worked on several large multi-country, multi-partner projects including IDRC/ FCDO funded Adaptation at Scale in Semi-arid Regions (ASSAR), British Academy funded Urban and Peri-urban Agriculture as Green Infrastructure, GIZ and Resilience First funded Summary for Urban Policymakers, and AfD funded Greening Urban Food Systems.

Prof. Subhrangshu Goswami
Assistant Provost (Academics), Head, CEPT Professional Programs (CPP), CEPT University

By education and training, Subhrangsu Goswami is an environmental planner (CEPT University) and environmental engineer. He holds a doctorate in public policy and administration. He has 20 years of professional experience as an academician, researcher, and consultant in the field of water & sanitation, urban infrastructure and services, and environmental planning. Before joining CEPT University, he was associated with PriceWaterhouseCoopers (PWC), Delhi, and worked closely with the Ministry of Housing and Urban Affairs (MoHUA), GoI. He has authored more than 25 publications which include research papers, journal articles, book, and book chapters. At CEPT University, he teaches courses on Urban Infrastructure Planning, Sustainable Development, Environmental Impact Assessment and Professional Practices for Planners.

Prof. Rajan Rawal
Senior Advisor, Center for Advanced Research in Building Science and Energy (CARBSE), CEPT Research and Development Foundation (CRDF)

Rajan Rawal is a Professor at CEPT University and a senior advisor at the Center for Advanced Research in Building Science and Energy (CARBSE), CEPT Research and Development Foundation (CRDF). He teaches energy-efficient built habitats, energy modelling, and energy policy at the postgraduate level and doctoral program levels. His work emphasis is on 'Energy Performance of Human Habitat' and 'Architectural and Building Science Education'. His current focus of work is on Passive Design Strategies, Net Zero Energy Buildings, Communities and Cities, Personal Thermal Comfort Systems, and Practices of Adaptive Thermal Comfort Models.

Dr. Sanjay Chikermane
Assistant Professor, Department of Civil Engineering, IIT Roorkee

Dr. Sanjay Chikermane is an Assistant Professor in the Department of Civil Engineering, Indian Institute of Technology, Roorkee specializing in structural engineering. He is Ph.D. holder from the Indian Institute of Technology, Bombay and has a Post Doctorate degree from the Indian Institute of Technology, Roorkee. He has published several articles, conference/ research papers and journal publications on the topics of sustainable materials and structural systems, structural health monitoring, etc. Some of his notable research projects are the conservation of traditional buildings and dissemination of traditional knowledge while simultaneously generating alternate livelihood opportunities, the reinterpretation of traditional technologies to create affordable resilient homes for rural communities and traditional community-based research. He has supervised several master's and Ph.D. dissertations.

Ms. Aparna Tandon
Senior Programme Leader, First Aid and Resilience for Cultural Heritage in Times of Crisis (FAR), ICCROM ICCROM

Aparna Tandon is a Senior Programme Leader at ICCROM. She leads the strategic design, partnership development, resource mobilization, as well as implementation of the First Aid and Resilience for Cultural

Heritage in Times of Crisis (FAR) - a flagship capacity development initiative of ICCROM, which protects heritage from the impacts of conflicts, disasters and climate change. She is the focal point in activities on Disaster Risk Management, Climate Action, Peace building and Sustaining Digital Heritage, Programmes Unit at ICCROM. Within the framework of the FAR programme, she is spearheading the research and capacity development on heritage-based climate action through Net Zero: Heritage for Climate Action, a two-year project backed by the Swedish Postcode Foundation.

Mr. Repaul Kanji
Disaster Risk Management (DRM) Professional

Repaul Kanji is a disaster risk management professional by training. He holds a Master's in Disaster Mitigation and Management and Ph.D. from the Indian Institute of Technology Roorkee. After having worked with and for the government at the state, national and regional levels, he has recently started working on his own socio-entrepreneurial venture - GRRID Corps, which is a transdisciplinary startup working at the crossroads of disaster risk management, climate action and sustainable development. He is engaged with INGOs like UNDRR, ICCROM in various capacities of consultant and trainer.

Ms. Shalini Dasgupta
ICOMOS India Focal Point for Climate Change and Heritage Working Group

Shalini Dasgupta is a Conservation Architect based in New Delhi and runs a multi- disciplinary practice offering services in Architecture, Interior Design & Conservation. Since starting 'Heritage Conservation & Design Centre', the firm has been focusing on adaptive reuse and putting historic buildings to contemporary use. She has been an active ICOMOS member since 2013 and currently holds the post of Vice President of ICOMOS India. She is also the national focal point for the Climate Change and Heritage Working Group of ICOMOS India. Her Doctoral Research is in the field of Heritage & Climate Change with an emphasis on thermal comfort in heritage buildings.

Mr. Gaurav Shorey
Founder and Managing Director, Psi Energy Pvt. Ltd. (Partnership for Sustainable India)

Gaurav Shorey has seventeen years of experience in green buildings design, engineering, training & capacity building. He is a founding member of the GRIHA Rating system. He is on the Technical Advisory Committee of GRIHA, SVA-GRIHA and GRIHA-LD. He has worked on over 200 green building projects globally and trained over 30,000 professionals in green buildings. He has now transitioned from energy and resource efficiency sector to education for sustainable development and inter-generational knowledge transfer focused on sustainability in the hyper-local context, and preservation of traditional knowledge systems for sustainable development and climate-change mitigation. He is a Visiting Faculty at SPA Delhi. He has a B.Arch degree from SPA Delhi and DACM from National Institute of Construction Management And Research (NICMAR), Pune.

Ms. Diane Bittar
Sector Portfolio Manager, Urban Development, French Development Agency, New Delhi

Diane Bittar is an architect and urban planner. She is in-charge of the urban development sector at the French Development Agency in New Delhi.
(Not able to find more details on internet)

Organizations

Cultural Resource Conservation Initiative (CRCI) India Pvt. Ltd.

CRCI India Pvt. Ltd. was founded as Cultural Resource Conservation Initiative (CRCI) in 1996 by conservation architect Gurmeet S. Rai. The vision of the organisation is to preserve and promote India's cultural heritage with active community participation. One of CRCI's early projects was a comprehensive listing program of historic buildings and sites across the state of Punjab. Over almost three decades of its inception, CRCI has enlarged its areas of expertise to encompass conservation of historic buildings and sites, preparation of conservation and heritage management plans for sites of significance, urban and area level development strategies integrating conservation, improved management and development of both cultural and natural heritage. CRCI has evolved culturally sensitive frameworks and mechanisms for project implementation by various government bodies. CRCI consistently tries to harmonise the imperatives of heritage conservation with the historic and current realities of the site. Towards this end, CRCI works in participation with communities to develop appropriate strategies for conservation in both rural and urban areas. CRCI's project on Conservation of Krishan Mandir, Kishankot, Punjab, India was awarded the UNESCO Asia- Pacific Heritage Award, 2001. In 2004, the firm was once again awarded the UNESCO Asia-Pacific Heritage Awards for the Conservation and Development of Gurudwara Darbar Guru Nanak Dev – Lakhpat, Kutch, Gujarat, India. CRCI's contribution to conservation was also acknowledged by the Government of Punjab through the Award for Excellence in the Field of Conservation Initiatives and Contributions to the State of Punjab, India, 2002.

Center for Heritage Conservation (CHC)

Center for Heritage Conservation (CHC) was established in 2019, under CEPT Research and Development Foundation (CRDF), which is the research and advisory arm of CEPT University, Ahmedabad. CHC focuses on advancing the discourse of built heritage conservation through the lenses of sustainability and equity in the Indian context. The Center collaborates on the most pioneering international research projects on the one hand and engages with the government, city administration, and industry on the other to inform policies and practices on the ground. The team at CHC approaches conservation as a comprehensive process that is situated in an ever-changing environment and constantly engages with all actors and stakeholders that are a part of that change. The educational activities conducted by the CHC team are recognized as one of the best practices internationally. Some of CHC's key activities include - creating a repository of knowledge of heritage conservation in India; engaging in research projects; advisory on aspects of heritage conservation and conservation-led regeneration with solutions that are long-term, implementable and equitable; conducting heritage assessments and heritage impact assessments; developing training and capacity building courses for professionals; using the potential of advanced digital technologies in the field of heritage conservation; and CEPT Conservation Site School initiative.

Urban Design Collective (UDC)

Urban Design Collective (UDC) is a Chennai-based collaborative platform for architects, urban designers and planners to create livable cities through participatory planning. UDC was founded in 2011 as a platform to mobilize those who want to change the way our cities are built. By providing an open platform for young design professionals, who otherwise as individuals are excluded in the city building process, to create and disseminate content, UDC gives them a chance to voice themselves as change-makers for better cities. As a result, UDC has come to be a global community of architects, designers, engineers, artists, writers, photographers and many others who are passionate about cities. UDC's approach is best defined as a mix of storytelling, advocacy and demonstration through practice. The approach is people-centric and aims to bring many stakeholders involved in the city building process as equal partners to concur on what makes livable cities.

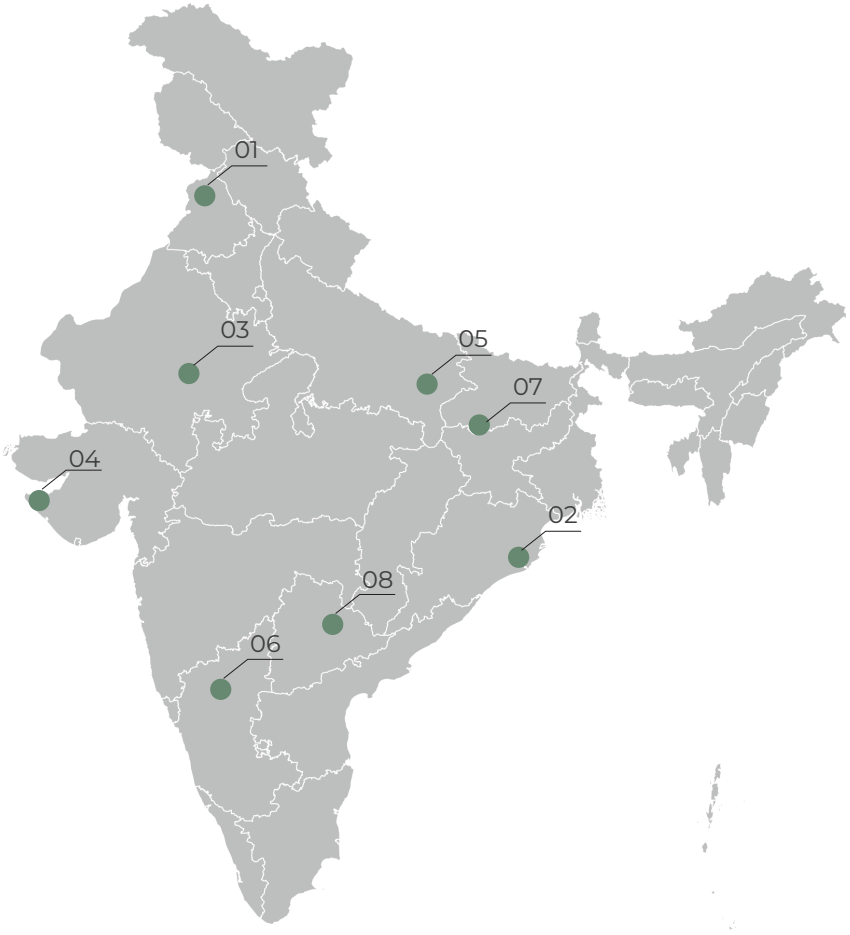
Acknowledgments

The project team would like to acknowledge several people who have supported the work for this compendium. We are thankful to Manvita Baradi, Paromita Desarkar, Shikha Jain and Vijaya Amjure for sharing the City HRIDAY Plans of Dwarka, Badami, Ajmer, Varanasi, Gaya and Warangal with us. We deeply appreciate the assistance and efforts of our colleagues at NIUA, the SPV teams of the 12 cities of the CITIIS program who provided inputs on matters of heritage conservation and management of their cities during the workshop held in Surat and Surat Municipal Corporation for hosting the workshop. We are thankful to Dr. Neelima Jerath for addressing the participants at the workshop and for giving insights into the work of Government of India in the area of Climate Action and further, Government of Punjab in preparing the State Action Plan. We are truly grateful to the speakers and the panellists at the webinar of this project for sharing their expertise and wisdom with us as well as for agreeing to share the content from their presentations as case studies for inclusion in this compendium.

Annexure 2

HRIDAY Scheme Case Studies

HRIDAY plans mainly focus on the preserving and revitalizing the heritage cities to improve the overall quality of life through provision and up-gradation of infrastructures, documenting heritage assets and creating linkages between tourism and cultural identity of the cities. However, these plans have not been designed for climate change concerns, but it does include strategies/ projects which caters to climate change issues and impacts. Selected case studies from these, are explained in this section through perspective of climate change. These case studies also consist initiatives/ plans by respective states and urban local bodies for vulnerabilities and hazards related to their particular areas. It helps in understanding the current efforts taken by the various level authorities to mitigate and adapt the impacts of climate change on historic cities.



01	Amritsar	05	Varanasi
02	Puri	06	Badami
03	Ajmer	07	Gaya
04	Dwarka	08	Warangal

Amritsar 1

Location	Typology	Population	Bio-geographic Zone
Punjab, India	City	11,83,549	Indo-Gangetic Plain

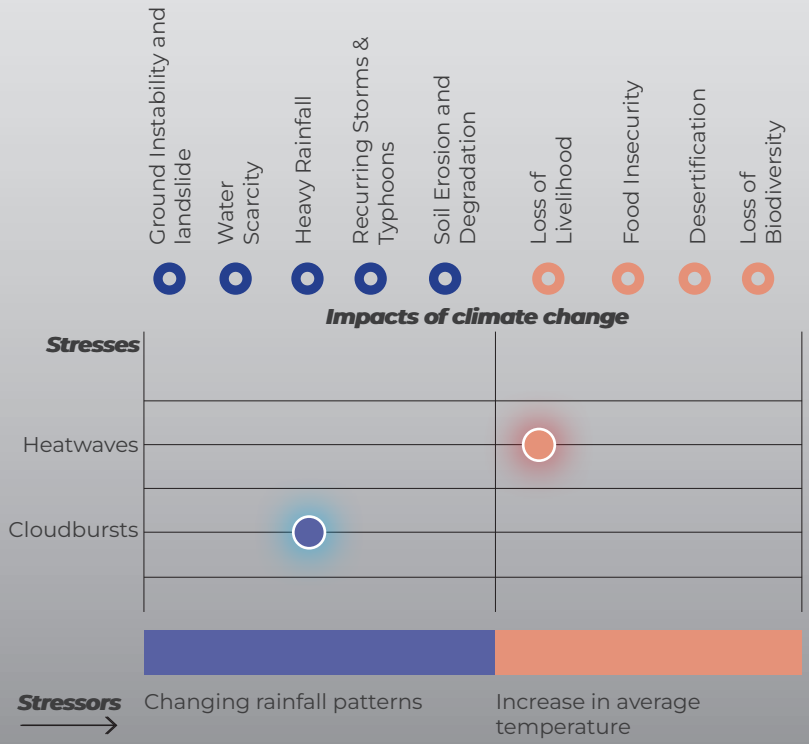
Heritage Profile

Amritsar is a repository of spiritual heritage for the Sikh community from across the globe. Every devout Sikh yearns to make a pilgrimage to Amritsar at least once in his or her lifetime and take a dip in the Amrit Sarovar. Amritsar, further, exemplifies the soul of the Majha region of Punjab, and is the focal point of the evolution of the Punjabi language, its idiom and literary traditions.

Climate Change Profile

Impacts of climate change

- Increase in heavy precipitation events
- Increase in flash floods
- Increase in the temperatures



Nature of Responses

Demonstration projects/ Proving by doing

Zone 1 : Ramdaspur heritage zone

Planting of trees / shrubs

- Deciduous trees was proposed to be planted for the shading and comfort of all road users in different seasons. At least 125 trees per km are recommended to be planted for lesser road width like 9 to 14 m. (Small tress- Cordia sebestena, Bauhinia blakeana, Plumeria alba, Nyctanthes arbor- tristis, Tabebuia rosea, Magnolia grandiflora)

Stormwater management

- Cleaning of existing stormwater drains and laying of stormwater drains was proposed as a combination of underground and surface drains responsive to road widths for 21 major roads leading to the Golden Temple critically including interventions towards improved stormwater drainage.
- Cleaning and maintenance of existing stormwater drains are proposed for all existing drains in wall city (15 km). To tackle the problem of water logging a network of stormwater drains is provided, integrated with the current drain. As all the streets are very narrow, so, all the drains are used for the conveyance of stormwater to the outside.
- For doing so three types of sections are worked out depending on the width of the road.
- Primary Road- More than 4 m, But mandatory in more than 6 m- Underground SW drain
- Secondary Road- 3 to 6 m- Standard open drain with cover
- Tertiary Road- Less than 3 m- As It Is or flushed road

Sewer

- Some households are connecting the sewer to the stormwater drain, thus further contaminating the stormwater. There are some missing links in the sewer leading the people to connect the sewer to the stormwater drain. The gaps in the system requires to be identified and a segregated stormwater drain and sewer drain was recommended to be provided.

Zone 2 : Rambagh Garden Recreational Zone

Tree planting zone

- Concerns regarding giving optimal climatic comfort within the extent of the protected monument with the landscape. The 'Clear Pedestrian Zone' (of minimum 1.8 M width) and 'Utility Easements' was proposed to be placed separately from the 'Tree Planting Zone'. Planting zones can also double as natural stormwater catchments and filtration systems - aiding in groundwater recharge, preventing seasonal flooding and reducing pressure on piped stormwater.
- At least 125 trees per km are proposed to be planted for lesser road widths like 9 to 14 meters. (Large trees- Delonix regia, Livistonia chinesis, Ficus infectoria, Erythrina variegated, Alsonia scholaris, Jacaranda Mimosifolia, Small tress- Cordia sebestena, Bauhinia blakeana, Plumeria alba, Nyctanthes arbor- tristis, Tabebuia rosea, Magnolia grandiflora)

Storm water drains (Surface and underground)

The street (Road from Crystal Chowk till Bhai Veer Singh Sadan) design was recommended to incorporate storm water along the street wherever possible. All the green buffer along

the road side of minimum width 1.5 mts and above are recommended to be used as infiltration strips like green gutters, swales, etc. The green buffer along the road edge should be used to capture the storm water from the roads. Infiltration and flow-through planters along the road edge of minimum 1 mts width are recommended which will act as structural landscaped reservoirs used to collect, filter, and infiltrate storm water runoff.

Zone 3 : Gobindgarh Fort and Durgiana Temple historic area

Planting of trees / shrubs

- Since trees are indispensable in harsh weather weather, space must compulsorily be carved out for them within the existing ROW (Right of Way).

Stormwater drains (Surface and underground)

- All roads leading up to Durgiana Temple and Gobindgarh Fort including road
- The buffer green along the road edge was proposed to be used to capture the stormwater from the roads. Infiltration and Flow-through planters along the road edge of a minimum 1 m width, will act as structural landscaped reservoirs to be used to collect, filter, and infiltrate stormwater runoff. They allow pollutants to settle and filter out as the water percolates through the planter soil and infiltrates into the ground.

Zone 4 : Circular Road Historic Connector

Solar system

- It was recommended to provide rain shelter and street lights with Solar panels.

Stormwater management

- All the surface water from the walled city flows out into Zone 4. A stormwater management plan is to be proposed to increase the groundwater filtration capacity of the area, which will further increase the groundwater table. Movement of stormwater was proposed to be directed into the roadside green through a gravel filter pit, which further leads the rainwater into the retention/ detention facilities proposed in the nearby parks or open areas with few recharge pits.

Zone 5 : Environmental Heritage Nodes

Interventions towards ecological consciousness

- Environmental park at the UBDC Canal was proposed. It was recommended for Environmental upgradation through softscape interventions with planting of local species of trees.

Rainwater harvesting and solar panels

- The proposal was made for rainwater harvesting and solar panels with rain shelter.
- It was recommended for Environmental upgradation through softscape interventions with the planting of local species of trees and flowering shrubs mirroring natural growth patterns towards creation of an environmental park.

Landscaping along the river

- It was proposed to restore and protect landscape and natural habitats along the river. Interventions such as, Bio-remediation techniques eliminate the need of expensive machines, power etc to clean up the wastewater following natural processes were proposed.

- Riparian buffers are a simple, inexpensive way to protect and improve water quality through local plant materials. Buffer strips structurally stabilize banks and shorelines to prevent erosion. Trees and shrubs were recommended to provide shade to maintain the consistent water temperature necessary for the survival of some aquatic life. The width of the buffer is based on the surrounding context, soil type, size and slope of the catchment area, and vegetative cover.

Planting of trees / shrubs

- Water-related plants were proposed, such as, Canna, Scrpus, Phragrnites, Typha

Latifolia, Cyperus, Eichhornia crassipes, Salix spp, Potamogeten nodosus, Sagittaria latifolia, ceratophyllum demersvm

Revitalization of 40 Khoo, or 40 wells and colonial period powerhouse

- The park is not utilized, therefore the proposal was to enhance recreational opportunities for the common man to allow him to engage with the city's natural bio-diversity, heritage etc.

Conservation of the well- Cheharta Gurudwara

- Conservation of the Well built by Guru Arjan Dev and Area was proposed for improvement. (Improvement of the road)

Stormwater management

- Interventions were proposed towards ecological consciousness through the provision of Rain Water Harvesting schemes and demonstration areas.

In All Zones

Rain water harvesting / Recharge pits

- Interventions were proposed towards ecological consciousness through the provision of soft scape/ green islands or belts and rainwater harvesting / Recharge pits, Green pockets linked with rainwater harvesting in all the zones.

Drinking water facilities

The proposal was made to provide new drinking water facilities.

Public toilets

It was recommended to provide new public toilets.

Policy regulations and Statutory measures

Zone 5 : Environmental Heritage Nodes

Stormwater management

- Interventions towards ecological consciousness through the provision of Rain Water Harvesting schemes and demonstration areas were proposed.

Agents of Change

Government	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC) National Technical Committee City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Municipal Corporation of Amritsar (MCA) Small Industries and Export Corporation (PSIEC) Punjab Urban Planning and Development Authority (PUDA) / Amritsar Development Authority Punjab Infrastructure Development Board (PIDB)

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

	Archaeological Survey of India (ASI) Chandigarh Circle Department of Cultural Affairs, Archaeology and Museum Punjab Heritage and Tourism Promotion Board (PHTPB) Public Works Department (Buildings and Roads) Department of Technical Education and Industrial Training (Skills Development Programmes) Amritsar Improvement Trust (AIT) Department of Irrigation Department of Horticulture Punjab Roadways Ministry of Railways
Private Sector	Shiromani Gurdwara Parbandhak Committee (SGPC) Shree Durgiana Management Committee Cultural Resource Conservation Initiative (CRCI)
Others	Religious Trusts Local Residents Tourists

Climate-related Concerns in Existing Plans

- The State Action Plan on Climate Change (Punjab SAPCC 1.0) was created by the Punjab state in the year 2014. Punjab SAPCC 2.0- 2021 to 2030 is under preparation. It includes Punjab Water Mission, Sustainable Agriculture Mission with Strategies for Agriculture and Horticulture, for Managing Livestock and Dairy and for Fisheries, Green India Mission, Sustaining Himalayan Ecosystem and Biodiversity Mission, Sustainable Habitats Mission, Renewable Energy Development and Solar Mission, Mission on Enhanced Energy Efficiency and Mission on Strategic Knowledge Management.

- Punjab State has prepared a disaster Management Plan and Energy Action Plan to reduce the impact of disasters and facilitate a swift and effective response. Amritsar district has developed a District Disaster Management Plan (DDMP) and District Environment Plan with the concern of disaster and environmental protection.

- Amritsar City Development Plan, 2012 incorporated the climate-related concerns and strategies of Water Supply, Sewerage and Stormwater management and it also comprised heritage-related concerns of Conservation, Preservation and Development of Heritage and Culture (Urban Renewal) and Promotion of Tourism. Amritsar Master Plan, 2010- 2031 has a vision to make land allocation for different urban uses in an environmentally sustainable manner. Making the city free from air, water, land and noise pollution. It involved the issues and strategies related to Forest Areas, Urban Environment, Urban Services, Solid Waste Management, Storm Water Disposal, Sewerage and Drainage. The proposed Land Use Plan has three more land uses which are Conservation, Forest Areas and Tourism.

- Amritsar city has developed an Action Plan for Clean Air, Amritsar in 2019. It has the vision to create awareness about the adverse impact of air pollution, identify the sources of Air pollution and their apportionment, set up facilities for treating the pollutants, ensure effective monitoring of the quality of air, mitigate adverse impact on the health of the people due to air pollution.

- With a moderate level of vulnerability, the Amritsar city's main hazards include flooding and drought. Corresponding to the city's hazards, Amritsar requires a specific plan / strategies to manage water to prevent floods and droughts.

2 Puri

Location
Odish, India

Typology
City

Population
2,00,564

Bio-geographic Zone
Coastal

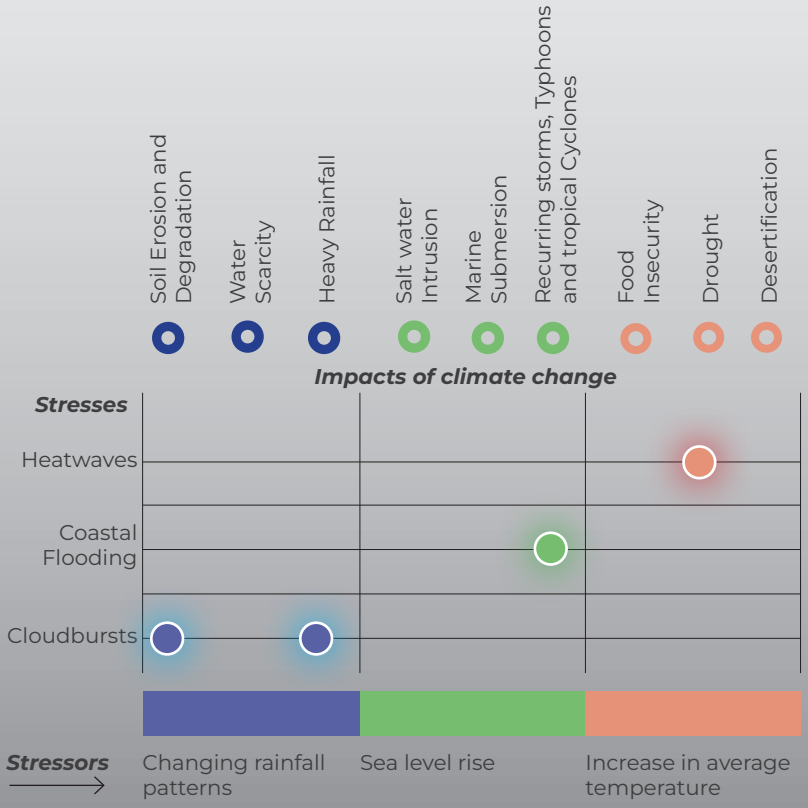
Heritage Profile

The city of Puri, historically known as Purushottama Kshetra, also Sankha-kshetra (a place in the form of a conch shell), is situated on the Bay of Bengal, on the East coast of India. It is located midway between Chilika and Konark. Geographically, it is bound by the sea to the south, the Musa River to the north, the Mangla River to the west and the Balukhanda Reserved Forest to the east.

Climate Change Profile

Impacts of climate change

- Increase in cyclones and floods,
- Coastal erosion or Accretion,
- Rising sea level,
- Increase in the temperatures,
- Excess Rainfall



Nature of Responses

Demonstration projects/ Proving by doing

Zone 1 : Shankha Kshetra Heritage Zone

Minimizing chaos

- On a normal day, most traffic on the Bada Danda Road is of people visiting the temple. The number of private vehicles on the road is limited. The right of way for mass transit, and motorized vehicles should be 14 m. (7m in both directions). The rest of the road was recommended to be used to enhance the economic and cultural potential of Bada Danda Road.
- Promoting a heritage environment for the visitors by controlling noise and air pollution on Bada Danda Road
- This zone was proposed to be a strictly no-honking (Silent) zone
- Provide civic infrastructure and amenities
- All the infrastructure provided in this zone was recommended to be of a temporary nature which can be moved during the Rath Yatra. The civic infrastructure and street furniture were proposed to be provided, such as garbage bins were proposed at 50m intervals.

Zone 2 : River Musa Environmental Zone

Restoring the natural ecology of river Musa by removal of water hyacinth

- The Water hyacinth and other invasive flora have an adverse impact on the water quality and aquatic life. To revitalize the river the invasive flora was proposed to be removed and measures taken to ensure that they don't return. There are several mechanisms for preventing the spread or eradication of water hyacinths. The three most common mechanisms proposed are mechanical, chemical, and biological. A combination of the mechanisms was recommended to be employed to eradicate the water hyacinth and invasive flora.
- Historically Musa used to drain into the Bay of Bengal and following the development of the Mangala river used to meet it. At present the western end of the River is blocked and several developments now occupy the area where the river used to flow. It was recommended to maintain a continuous flow of water in Musa River in order for the river to be healthy.

Restoring a continuous, functioning riparian ecosystem along the river by creating a green flood zone

- At present the riparian ecosystem of Musa is severely degraded. A functional riparian habitat and wetlands have several benefits including improvement of water quality by removing or sequestering many contaminants.
- Where natural riverbanks exist, it was recommended to be managed as a natural sloped bank, landscaped with native riparian vegetation.

Making the river accessible by doing access distribution and maximum lengths

- Access to the waterfront was advised to be provided at regular intervals. There are a variety of metrics that can characterize and promote accessibility to the river, which are, points of interaction with the river, distances between the points of interaction and activities & programs along these points of interaction.
- It was recommended to opt for Sustainable Connection Typologies such as, natural terraces as connections, boardwalk connections, bridges for pedestrians and cyclists.

Protection of river

- The riverbanks, flood plains, and the river was recommended to view as protected areas with only activities associated with access to them, and pedestrian walkways are allowed.

A healthy river with flowing water

- Historically the Musa River used to connect with the Mangala River; however, the connection is now blocked. The river should be re-connected with the Mangala River.
- The river cross-section should be narrowed and deepened so as to increase the velocity of water flowing in the river and prevent stagnation and the build-up of weeds, water hyacinth, and other such flora.

Public space for the city

- The proposal was made to provide high quality public spaces and gardens along the river. A comprehensive Eco-Mobility route was proposed to run along the river to provide linear connectivity. This area was recommended to be landscaped and have cycle paths and pedestrian walkways, public spaces, and green areas.

Maintenance and cleaning of water tanks

- The proposal was made for using a net such as used in swimming pools for cleaning out large materials that are floating on the surface or have settled to the bottom of the pond. This was advised to be done regularly to prevent a build-up of solid waste. The proposal for Biological filtration systems for the cleaning of water and to assist in preventing of build-up of algae and similar fauna and flora was made.

Sewage treatment plan

- The open drains which carry 30% of Puri's wastewater and runoff end in the Musa River, a Sewage Treatment Plant was proposed to set up to treat the wastewater before it is allowed to be discharged into the Musa River.
- The plan STP and other infrastructure along the riverfront to meet future demand was proposed. The Sewage Treatment Plant (STP) is required to be of adequate capacity to meet the demands of the new developments. The treated water from the STP is required to be discharged into the Musa which will assist in maintaining water levels in the river. The existing open drains were proposed to be intercepted and connected by a pipeline that ends at the STP.

Climatic response for human comfort: Landscape strategy

- For a successful and sustainable landscape strategy, the choice of trees and plants requires consideration of the water table, climate, and local conditions. The best-suited trees and plants are those that are native to the region as they are less prone to diseases, have lower maintenance requirements, and also serve as better habitats for local birds and fauna. The proposal was made to achieve high levels of human comfort as one of the key objectives of landscape design. It was recommended to achieve by providing a high level of shading (65% of the area must be shaded) identifying wind corridors and adjusting the planting strategy to allow for smooth wind flow.

Drainage facilities

- Catch pits for runoff requires to be located at regular intervals, depending on their size and the catchment area, and at the lowest point of the street cross-section. Drain surfaces was proposed to be at grade with the surrounding street surface unless provided in landscaped areas. The number of stormwater lines in the cross-section were recommended to be minimized to keep construction and maintenance costs low.

Zone 3 : Balukhanda Recreational Zone

Encourage responsive development on the beach by providing ecologically sensitive area

- The ecologically sensitive area extends from the low tide line up to 30m inland from the high tide line. The proposal was made that no development (temporary or permanent nature) is permitted in this area. Activities in this zone was recommended to be planned and managed so as not to have any adverse effects on the beach, the ecology, and risks to lives and the sea. The remaining landward area of the beach (from the edge of the road up to the 30m setback from the high tide line) was recommended to be used as a vegetative buffer area or activity area.

Introduce native vegetation on the beach

- Vegetative Buffer was proposed to provide along the length of the beach which shall be planted with native seafront vegetation. The width of the buffer area can vary as per the activity planning of the beach.

Climate response for human comfort

- The footpath towards the building edge is required to have trees to provide shade. 1.5m is dedicated to landscape and street elements and 1.5m is a dedicated walkway. For a successful and sustainable landscape strategy, the choice of trees and plants is proposed to be based on consideration of water table, climate, and local conditions. The best-suited trees and plants are those native to the region as they are less prone to diseases, have lower maintenance requirements, and also serve as better habitats for the local birds and fauna.

Allotting space for all activities

- Public amenities like toilets, changing facilities, drinking water facilities, life guard, and first-aid centers were proposed to be upgraded to cater to the population visiting the beach.

Drainage facilities

- Catch pits for runoff was proposed to be located at regular intervals, depending on their size and the catchment area, and at the lowest point of the street cross-section. Drain surfaces should be at grade with the surrounding street surface unless provided in landscaped areas. The number of stormwater lines in the cross-section were proposed to be minimized to keep construction and maintenance costs low.

Innovation and social enterprises

Zone 2 : River Musa Environmental Zone

Creating new programmes for Musa educative ecology walks

- It was proposed that Musa river can contribute to Nature Trails and Educative Ecology walks to promote eco-tourism and educative tours for the citizens and children of Puri.
- On restoration of the levels and quality of water, the river would be suitable for access by humans, several new activities were proposed to be introduced in the river to keep the water moving and prevent the river from becoming stagnant.

Agents of Change

Government	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) HRIDAY National Empowered Committee (HNEC) National Technical Committee

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

Government	City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Archaeological Survey of India (ASI) Bhubaneswar Circle Public Works Department (PWD) Housing and Urban Development Department of Tourism Department of Horticulture Department of Transport Odisha State Archaeology Puri Municipality Puri Konark Development Authority (PKDA) Puri Irrigation Division Beach Development Authority Punjab Infrastructure Development Board (PIDB) Archaeological Survey of India (ASI) Chandigarh Circle Department of Cultural Affairs, Archaeology and Museum Punjab Heritage and Tourism Promotion Board (PHTPB) Public Works Department (Buildings and Roads)
Private	Cultural Resource Conservation Initiative (CRCI)

- The State Action Plan on Climate Change (Odisha SAPCC) was created by the Odisha state for the period of year 2018 to 2023. It includes concerns and strategies related to Health, Transport, Urban Development, Forestry, Energy, Coast and Disaster Risk Management, Agriculture, Waste management, Water Resources, Urban Development, Mining, Industries, Fishery and animal resources development.

- Odisha state has prepared a State Disaster Management Plan. Odisha is India's most disaster-ready state and the state's plan and strategies became a role model to other states, especially for cyclone management. Puri District Disaster Management Plan comprises concerns and strategies for Heat Waves, cyclones, Tsunamis, Energy, Transport, Industry, Agriculture, Forestry and Waste management. It also incorporates the Restoration and rehabilitation of houses in the recovery phase. Puri district has also been selected for the Climate Change Adaption- Disaster Risk Reduction Project, 2015- 2017.

- Comprehensive City Development Plan, Puri- 2031 comprises strategies and recommendations regarding Water Supply, Waste Water Management, Sanitation, Storm Water Management, Solid Waste Management, Waste Management in the Beach Area and Disaster Management. It also consists the Demarcation of Heritage Zones, Urban Design Guidelines for Heritage Zone and Tourism Management Plan. Puri city also has Coastal Zone Management Plans to protect the natural assets, biodiversity and cultural heritage of the coastal area.

- Puri city has developed a City Sanitation Plan in 2012. It has the vision to improve Storm Water Management, Waste Water Management, Faecal Sludge Management, Solid Waste Management and Access to Toilets.

- With a very high level of vulnerability, Puri city's main hazards include Flood, Drought and Cyclones. Corresponding to the city's hazards, Puri requires a specific plan / strategies to manage cyclones and water to prevent floods and droughts.

Ajmer 3

Location
Rajasthan, India

Typology
City

Population
5,42,321 - Ajmer City
21,626 - Pushkar City

Bio-geographic Zone
Desert / Arid Zone

Heritage Profile

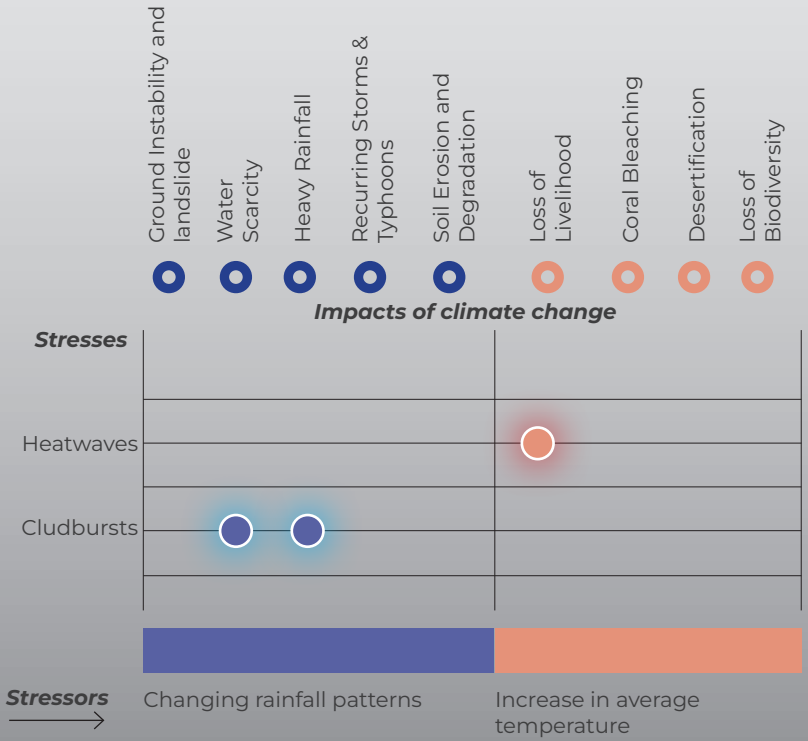
Ajmer is situated in the cradle of the Aravalli mountain ranges, surrounded by three hills of the Aravalli Ranges. Home to the Sufi saint Khwaja Moinuddin Chisti, Ajmer is a leading center for pilgrimage and attracts millions of visitors each year across faiths.

Furthermore, located just 11 km northwest of Ajmer, is the historic town of Pushkar, an ancient site for pilgrimage for Hindus since it is home to the Brahma Temple, the only one of its kind within the country. The natural topography has resulted in the creation of a number of waterbodies which form an integral part of the city today.

Climate Change Profile

Impacts of climate change

- Rising Temperature
- Drought
- Changing rainfall pattern



Nature of Responses

Demonstration projects/ Proving by doing

Heritage Area 1: Naya Bazaar

Improvement of existing public facilities

- The proposal was made to provide two drinking water points, one toilet, and four urinals. The two drinking water points on the Heritage Walk route were proposed to be upgraded to make them usable and hygienic. The proposal was made to make them disabled-friendly also.

Improvement of drains with covers and repair work

- In the entire 1.8 km stretch, improvement of drains was recommended. Drains in the residential neighborhood were proposed to be covered, and the existing drains to be repaired wherever broken.

Heritage Area 2: Anasagar and Foysagar Lakefronts

Lake ecology improvement

- The recommendation was made for the desilting of Anasagar Lake. The recommendation includes de-silting of Anasagar Lake, for cleaning, to improve water storage capacity and improve water quality.

Ram Prasad Ghat restoration and beautification

- Aesthetic improvement of the lakefronts by the creation of public areas at various points with seating, paving, dustbins, proper signage was proposed.

Heritage Area 4: Brahma Temple and Pushkar Lake

Solid waste management

- Installation of waste bins in the entire stretch was recommended.

Improvement of public facilities

- The proposal was made to provide two drinking water points, four urinals and two toilet complexes.

Improvement of drains with covers and repair work

- Drains in the residential neighborhood was proposed to be covered and the existing drains to be repaired wherever broken.

Agents of Change

Government	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC)

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

	National Technical Committee City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Ajmer Development Authority Ajmer Municipal Corporation Archaeological Survey of India (ASI) Jaipur Circle State Archaeology Ajmer Vidyut Vitran Nigam Ltd. City Level Advisory and Monitoring Committee City Mission Directorate Public Health and Engineering Department Nagar Palika Pushkar
Private Sector	INTACH Rajasthan Chapter Indian Heritage Cities Network Development and Research Organisation for Nature, Arts and Heritage - Dronah Foundation
Others	Devasthan and Temple Trusts Dargah Committee Members Local Residents Tourists

Climate-related Concerns in Existing Plans

- The State Action Plan on Climate Change (Rajasthan SAPCC) was created by the Rajasthan state in the year 2022. It outlines the State's strategies for a range of sectors that are relevant to its economy and local livelihoods – water, agriculture, health, forest and biodiversity, socioeconomic growth, and urban governance.

- Rajasthan State has prepared a State Disaster Management Plan in the year 2014. It includes the vulnerability of different parts of the State to different forms of disasters, the measures to be adopted for prevention and mitigation of disasters and the manner in which the mitigation measures shall be integrated with development plans and projects. It also consists the capacity building and preparedness measures to be taken, the roles and responsibilities of each department of the State Government in the context of the above and the roles and responsibilities of different departments of the State Government in responding to any disaster situation or disaster as well.

- City Development Plan for Ajmer & Pushkar was prepared to integrate infrastructure requirements and environmental concerns together with land-use patterns and regulation of the same. It involves projects in the area of water supply, sewerage, sanitation, drainage, solid waste management, road & transport, tourism & heritage conservation and lake rejuvenation also.

- Highly sensitive to climate change, Rajasthan is prone to extreme events such as erratic rainfall with frequent dry spells, occasional heavy downpours, extreme temperatures in both summer and winter, sandstorms, droughts, famines, and floods. Hence, it requires a specific plan to manage drought and extreme temperatures.

4 Dwarka

Location

Gujarat, India

Typology

Precinct

Population

38,873 - Dwarka
7177 - Bet Dwarka

Bio-geographic Zone

Semi Arid Zone

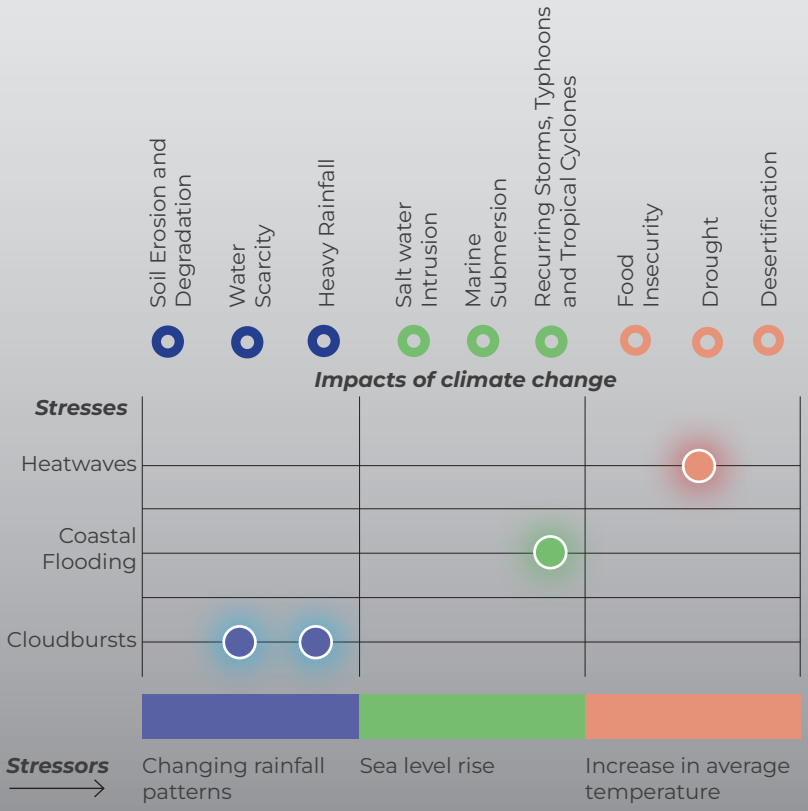
Heritage Profile

The ancient city of Dwarka is located on the western tip of the Saurashtra peninsula in Gujarat, India. Dwarka is one of the seven sacred cities of India as well as one of the Char Dhams of the Hindu pilgrim circuit set up by Adi Shankaracharya. Owing to its religious, historic and architectural value. Dwarka is the meeting point of the Arabian sea and Gomati river. Bet Dwarka- an island around 30 km away from the main town is an integral part of the heritage. Dwarka houses one of the oldest marine archaeological sites in the country.

Climate Change Profile

Impacts of climate change

- Frequent Cyclone



Nature of Responses

Demonstration projects/ Proving by doing

Zone 1: Development of the forecourt of Dwarkadhish Temple

Landscape development

- The proposal was made for planting trees / plants for natural shading, as there is no shade for visitors in the square.

Stormwater management plan

- The proposal was made to make stormwater management plan to prevent the issue of water drainage.
- If it is on a pedestrian footpath, the manhole was proosoed to be lined with a cast-in-situ RCC slab so as to prevent damage to the manhole in case the stone or block is damaged. The manhole cover was recommended to be made of stone similar to the material of the pedestrian footpath and shall be heavy enough so as to prevent theft or vandalism. If it is on a carriageway, the manhole was proposed to be as per the standard procedure carried by the municipality.

Zone 2: Development of Vegetable Market

Landscape development as public space

- The proposal was made to plant trees/plants in the public spaces.

Zone 3: Development of Siddheshwar Mahadev

Repair of the stepwell

- The recommendations were made to repair and restore the dilapidated stepwell (Savitri Vav) as per design.

Zone 4: Development of street from Iskon Gate to Dwarkadhish Temple

Landscape development

- The proposal was made to plant trees/plants in the public spaces.

Developing the water bodies

- Tourism Corporation of Gujarat Limited (TCGL) and Gujarat Pavitra Yatradham Vikas Board (GPYVB) have revived the Kaklash Kund and Ravala Kund.

In All Zones

Improvement of existing public facilities

- It was proposed to provide new drinking water facilities.
- It was recommended to provide new public toilets, renovate the existing public toilet, and hand over cleaning of the public toilet to the proposed SPV for O&M.
- Providing garbage bins at particular intervals and suitable locations to maintain hygiene and cleanliness of the space was recommended.

Agents of Change

Government	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC)

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

	National Technical Committee City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Dwarka Municipality Okha Municipality Gujarat Housing and Urban Development Department City Level Advisory and Monitoring Committee (CLAMC) Department of Tourism, Government of Gujarat (GoG) Archaeological Survey of India (ASI) Rajkot Circle, Dwarka Sub Circle Tourism Corporation of Gujarat Limited (TCGL) Gujarat Pavitra Yatradham Vikas Board (GPYVB) National Institute of Oceanography (NIO) Integrated Coastal Zone Management (ICZM) Marine Resource Conservation and Information Centre (MRCI) National Coastal Zone Management Authority (NCZMA) City Mission Directorate (CMD) Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) Gujarat Industrial and Technical Consultancy Organisation (GITCO) Gujarat State Water Supply and Sewerage Board (GWSSB) Gujarat Electricity Board (GEB) Gujarat State Road Transport Corporation (GSRTC) Indian Railways
Private Sector	The Dwarka Devasthan Samiti Dwarka Devasthan Samiti Sharda Trust Math (Sharda Pith) Reliance Industries Limited (RIL) Urban Management Centre (UMC)
	Representatives of hotels and restaurants Local people including Rayka artists, people running homestays, vegetable vendors, local priests and shopkeepers

Climate-related Concerns in Existing Plans

- The State Action Plan on Climate Change (Gujarat SAPCC) was created by the Gujarat state in the year 2014, it was again refined in the year 2021. It Includes concerns and strategies related to Drought and famine, Flood, Severe Storm / Cyclones, Rising Sea Levels, Extreme precipitation and waterlogging, Groundwater depletion, Groundwater contamination and water pollution, Crop and Agriculture, Cyclones and tsunamis, Earthquakes, Wildlife and biodiversity conservation, Forest fire and pollution

.

- Gujarat state has prepared a State Disaster Management Plan in the year 2016-17 to ensure effective disaster management and response within the state to reduce the social and economic impact of disasters. Devbhoomi Dwarka District also has a Disaster Management Plan- 2022, particularly for the district. It comprises probable Mitigation Measures for Flood, Cyclone, Earthquakes, Droughts, Tsunami and Industrial (Chemical) Structural Measures. It also includes the promotion of Traditional, local and innovative practices.

- With a high level of vulnerability, the Varanasi city's main hazards include floods, Drought and Cyclones. Corresponding to the city's hazards, Dwarka requires a specific plan / strategies to manage Cyclones and water to prevent floods and droughts.

Varanasi 5

Location	Typology	Population	Bio-geographic Zone
Uttar Pradesh, India	City	2,12,037	Indo-Gangetic Plains

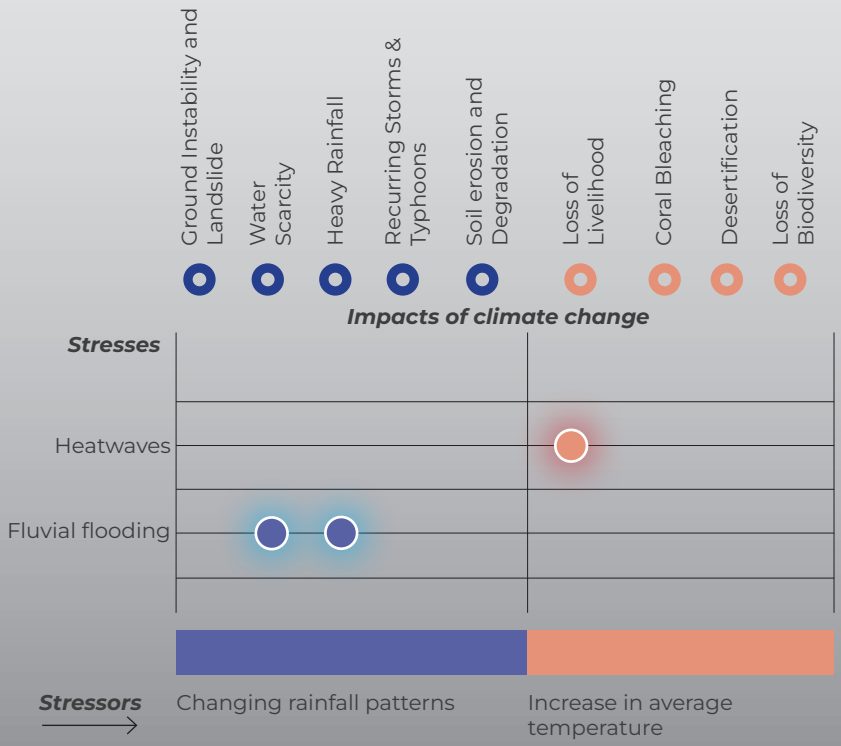
Heritage Profile

Varanasi, also known as Benares or Kashi, is situated on the banks of the river Ganga. It is said to be the oldest living city in the world and is heterogeneous with multiple layers of religion, culture, art forms, profiles and individual qualities. It is sacred and holy to Hindu, Buddhist, Jain and Muslim religions. Varanasi is also an important spiritual center for many religions such as Hinduism, Buddhism, Jainism and Sikhism. It is most famously associated with Lord Shiva and is known as the holiest of holy Hindu cities.

Climate Change Profile

Impacts of climate change

- *Increase in Floods*
- *Rising Temperature*



Demonstration projects/ Proving by doing

Zone 1: Ghats on Ganga River Front

Solid waste management

- There is an accumulation of garbage and debris on the Ghats and there are very few dustbins on the Ghats, which are also in a derelict condition. Solid waste management was proposed to be addressed through Bio-compost and provision for dustbins along the ghats.

Deterioration due to lack of maintenance

- Due to lack of maintenance, some of the ghats are deteriorating with time with broken steps and vegetation growth like Bhaidani Ghat, Boondi Parkota Ghat and Gola Ghat. Ghats are in urgent need of restoration. The ghats along the river Ganga, are prone to deterioration due to the rising level of water of the river, which causes the ghats to submerge under water causing erosion and deterioration of the stone steps during peak rainy season. The ecological value of the Ghats is high as it is located along river Ganga and two important rivers - River Assi and River Varuna. Together it form an important ecosystem of Varanasi which impacts the Ghats and its related rituals. The maintenance of these ghats was proposed.

De-siltation

- Some ghats have siltation like Ram Ghat, Jalasan Ghat, Teliyana Ghat. De-siltation steps were propsoed on these ghats.

Sewerage

- There are 6 sewage treatment plants located at Trilochan Ghat, Mansarovar Ghat, Jalasen Ghat, Harish Chandra Ghat, Nagwa Ghat, and Dr. Ranjendra Prasad Ghat. Sewage treatment of only 87 MLD (Millions of Liter per Day) is done while 130 MLD sewerage is dumped untreated. At some ghats, there are sewers that open into the Ganga, hence polluting it like Bhaidani Ghat, Chowki Ghat, Boondi Parkota Ghat and Gola Ghat. There is an issue of direct sewage discharge into the river. Hence, proper stormwater drains and sewer drains were proposed to be provided. Diversion of sewers from Ganga into the interceptors which are already located on the ghats was recommended,

Drainage

- Stormwater drains are present at Gola, Trilochan, Mansarovar, Harishchandra, rajghat, Shivala, Brahma, Jawala Sen, Manikarnika, Ganesh, Naradghat, Teliyana, Assi and Nakhi. Assi Ghat has a water logging problem and the waste water outlet is dysfunctional. A proper drainage system was recommended to be installed on the ghats.

Zone 2 : Old city area of Varanasi

Revival of Kunds

- In the old city, there are many Kunds of high significance such as Lolark Kund which has high ecological value. Revival of Durga Kund (7500 sq m), Pushkar Talab (8000 sq m) and Kurukshetra Pokhra (2500 sq m) was proposed.

Solid waste disposal

- There is inefficient solid waste management in the old city. The streets are littered with garbage as there are insufficient garbage bins and containers. Provision of dustbins for efficient solid waste collection which otherwise is littered on the streets and treating the waste collected and the temple waste through Bio-compost was proposed.

Stormwater drainage

- Development of 15 identified roads linking the heritage sites within Bangali Tola, Vishwanath Gali, and the street leading from Godowlia Chowk to Dasashwamedh Ghat including repair, paving, and stormwater drainage was recommended.

Zone 3 : Sankat Mochan Durga Kund

Solid waste

- Insufficient stormwater drainage and solid waste disposal lead to extreme water logging in the monsoon months. Efficient solid waste collection and drainage around the temples and kunds with the provision of dustbins and treatment of waste collected from the area through bioneers was recommended.

Groundwater recharge

- The kunds and talabs in the area have lost the groundwater recharge as the areas around have been built up and are dirty and not maintained. The kunds and pokhras are non-functional due to the encroachment of their catchment area. Therefore, it was proposed that conserving and reviving the ecological cycle by reviving the Kurukshetra Pokhra, Pushkar Talab and Durga Kund is needed.

Stormwater drainage

- Providing strome water drainage as there is insufficient stormwater drainage and solid waste disposal leads to extreme water logging in the monsoon months was recommended.

Zone 4 : Peeli Kothi (Area of Weavers)

Solid waste collection, management and disposal in the Mohalla

- The area lacks a proper drainage system with chocked drains and water logging in the monsoon. The public spaces and chowks become garbage dumping grounds as there is no separate area for solid waste disposal or regular garbage collection. For efficient solid waste management, it was proposed to provide dustbins at regular intervals and identify locations to collect the solid waste being disposed of in the streets.

Zone 5 : Assi Nala

Cleaning and development of Assi Nala / Riverfront

- 'Varuna-Assi', such is the significance of this river as it was a part of the hydrological system of Varanasi, therefore it has high ecological value. It has been polluted beyond recognition today. The Nala has the potential to be cleaned and revived as a river again and develop as a riverfront. Therefore, bringing back the hydrological cycle of which it was once a part of was proposed.

Zone 6 : Sarnath

Revival and development of sacred water tanks

- Sarnath Kund, Sarangnath Talab are important parts of the ecosystem that shape the site of Sarnath. Revival of Sarangnath Kund and Sarnath Talab which are of high historic and ecological value and developing them as public open spaces was recommended.

Solid waste management

Solid waste disposal was proposed to be made efficient by the provision of dustbins at regular intervals.

Proposed plantation for sacred landscape

- Revival of river and improvement of water quality by using bio-remedial plants was proposed along with landscaping and development of recreational open space along the river.
- Proposed Indigenous trees and shrubs are Carissa Macroca, Kher Tree, Durenta Golden, Duranta Golden Edge, Mussanenda Eryth Ropphylla, Golden Dewdrop, Ficus Benjamina, Cosmos Yellow Bush, Adhakpuspi Flower, Kariyatharani Plants, Duckweed, Water Lily Bottom Rooted and Floating, Neem- Azadirachta Indica, Champa- Magolia Champaca, Peepal- Flcus Religiosa, Mango- Mangifera Indica, Nagchampa- Couroupita Guianensis, Banyan- Ficus Benghalensis, Tulsi- Ocimum Tenuiflorum, Bael- Aegle Marmeloshampaca.

Stormwater drainage

- Provision of storm water drainage system to avoid any kind of water logging in the area causing the roads to deteriorate and hence causing inconvenience to the visitors was recommended.

In all zones

Improvement of existing public facilities

Provision of public toilets and drinking water stations for catering to the high footfall of tourists was proposed.

Policy regulations and Statutory measures

No construction zones from the heritage delined area

- The proposal is not to develop in 200 meters activity area on the eastern bank of the River Ganga (upper Lowland) has started to develop and encroach upon even after applicable regulation. The proposal for the Riparian corridor is to provide a buffer and protection of critical habitats for Biodiversity. These narrow areas along river banks are potential conservation areas vital for sustainable agriculture as well as for fisheries as a local livelihood. It will protect the ecologically sensitive riverfront heritage.

- Protection of rights of tribes and rural settlements that have been traditionally sustained upon forests. There are several Scheduled Tribes in Varanasi and surrounding areas that may be dependent, as well as the many villages that have been included in the VDA (Varanasi Development Authority) jurisdiction.

Agents of Change

Government	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC) National Technical Committee City Level Advisory and Monitoring Committee (CLAMC)

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

Government	City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Varanasi Municipal Corporation (VMC) Varanasi Development Authority (VDA) Archaeological Survey oWf India (ASI) Sarnath Circle Uttar Pradesh State Archeology Department Uttar Pradesh Tourism Development Corporation Town and Country Planning Department (TCPA) District Urban Development Authority (DUDA) City Level Advisory and Monitoring Committee (CLAMC) Uttar Pradesh Control Board (UPPCB) Public Works Department (PWD) Sate Urban Department Authority (SUDA) UP Jal Nigam (JN) Varanasi Jal Sansthan (JS)
Private sector	Indian National Trust for Art and Cultural Heritage (INTACH) Architecture Division and INTACH Varanasi Chapter
Others	Temple Trusts Maths trust Local Residents Tourists

Climate-related Concerns in Existing Plans

- The State Action Plan on Climate Change (Uttar Pradesh SAPCC) was created by the Uttar Pradesh state in the year 2014. It Includes Sustainable Agriculture Mission, Energy Efficiency Mission, Green UP Forestry Mission, Jal Mission, Strategic Knowledge Mission, Sustainable Habitat Mission, Disaster Management, and Health Mission.

- Uttar Pradesh state has prepared a State Disaster Management Plan to ensure a coordinated and efficient response during times of disaster emergencies. The state has also developed Flood Action Plan- 2023 to improve flood management, reduce vulnerabilities and safeguard the well-being of the state's residents by promoting resilience and minimizing the impact of flooding events.

- Varanasi City Development Plan, 2015 incorporated the climate concerns and strategies of Water supply improvement, sewage system, Storm water drains, Solid waste management, Environment management, Water body management, Riverfront development and recommendations related to the Heritage and Tourism Development sector.

- Varanasi city has developed the Solid Waste Management Plan in 2019. It has the vision to improve the primary collection of solid waste, to decentralize the treatment of waste and to develop a system for the collection and disposal of construction waste.

- Even though Varanasi has a low level of vulnerability to flooding and drought, a specific plan/ strategy is required to manage water to prevent floods and droughts.

6 Badami

Location
Bagalkot District
Karnataka, India

Typology
Precinct

Population
30,943

Bio-geographic Zone
Deccan Plateau and
Southern Peninsular Plains

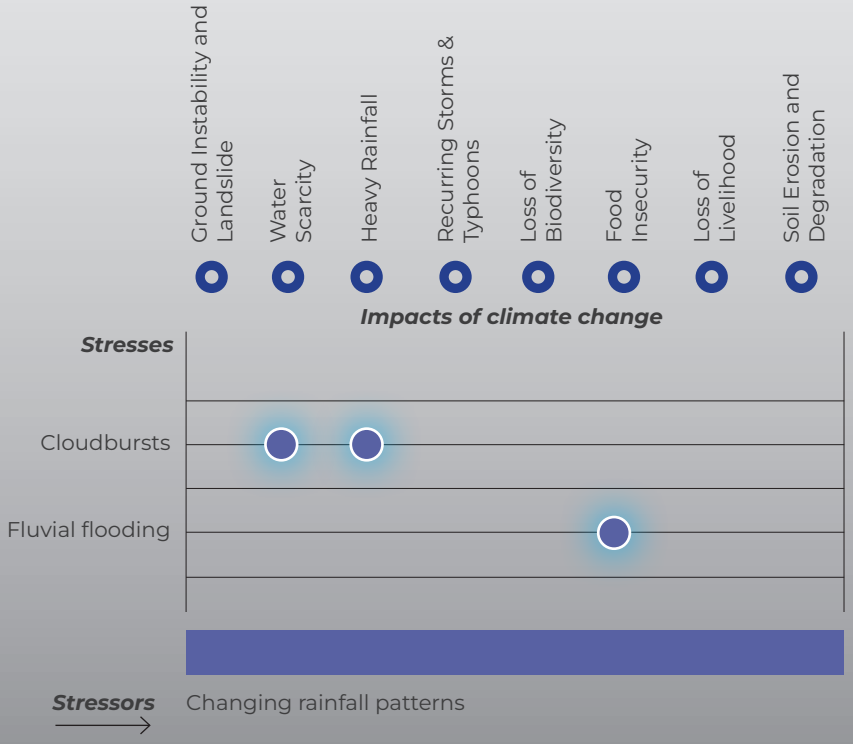
Heritage Profile

Badami, once the capital of the Chalukya dynasty, holds cultural and architectural significance due to cave temples and Badami fort. Badami, is one of the most important and historical towns in the Bagalkot district in Karnataka renowned for its rich architectural, natural and cultural heritage. Badami served as the second capital for the early Chalukyas dynasty in the 5 to 7th Century AD.

Climate Change Profile

Impacts of climate change

- *Increase in heavy precipitation events*
- *Increase in floods*



Nature of Responses

Demonstration projects/ Proving by doing

Zone 1: Agastya Teertha Heritage Precinct

Landscaping and environmental improvement

- Providing landscaping elements, including hedges, ground cover and trees, dustbins, etc. around Agastya Teertha Lake was recommended.

De-Siltation

- Desiltation of Agastya Teertha tank / feeder channel was recommended.

Development of archaeological and nature park above North Hill

- The project is proposed to safeguard and highlight the local natural and built heritage assets of Badami. The Agastya valley, coupled with Mahakut valley and Naganath valley in the proximity of about ten kilometers, is rich with varied medicinal plants and the area has been the source of inspiration for those who are in search of Ayurvedic Heritage. However, this unique aspect of Badami is virtually unknown. Therefore, it was proposed to create a series of Herbal Gardens on 8 acres of the land out of the available 11 acres which is aimed at restoring the medicinal properties of the Agastya Tank. This site is close to the rock climbing areas of Badami and hence it was proposed to have provisions for open spaces for tent pitching for camping with minimal interventions including water points, 2-3 mandapas, mobile toilets, dustbins etc. which will help promote adventure tourism and provide exquisite facilities.

Sullage treatment

- The Agastya Teertha, is the only water body and one of the most prominent natural features identified in the Heritage Core of Badami. Traditionally, it was the main source of water for the settlement. The present use of the water tank for washing and sullage flow into it from the nearby settlement greatly compromises the water of the lake and is unable to cater to the drinking water standards and requirements of the town. The objectives of this project included maintaining the water quality of the Agastya Teertha tank, ensuring sustainable use of the water present in the tank and improving hygienic conditions of the adjoining village of Tattkote.

Surface drainage system

- The proposed surface drainage system in Tattakote village would prevent sullage from Tattakote village entering the Agastya tank. The 3 existing shallow drainage system drains would be intercepted and lead to an open drainage network.

Sullage treatment plant details of plan

- It was proposed to provide a mobile sewage treatment solution for the site that offers a highly flexible wastewater treatment facility which will have very few requirements on its installation on site, considering that the area comes in the vicinity of protected monuments.

Wash Pens with Water Supply

- The existing pumping station belonging to the ASI is proposed to be diverted from the sprinkler system and used to provide water supply to the wash pens.
- It was recommended to restrict washing alongside the lake by means of security patrolling which can be done with the help of the local community.

Natural treatment of drainage

- The existing concrete wall being an inappropriate intervention is proposed to alternatively be retained since removing the existing concrete would involve gouging with drills and could potentially damage the nearby rocks. However, it was recommended to provide weep holes in the existing concrete wall to allow for water seepage. The existing concrete status was recommended to be relocated to a more prominent open public space and provisions to be made for slope stabilization and preventive works for erosion and differential sedimentation along the watershed areas of the lake. Provision for natural treatment of drainage and plantations in the watershed areas including medicinal plants which were historically part of the natural ecosystem of this area was proposed.

Improvement of public facilities

- Provision of public toilets and drinking water stations for catering to the tourists was proposed.

Zone 2: Historic Old Settlement Core

Solid waste management system

- Provision of garbage bins for biodegradable and non-biodegradable waste at individual households was recommended. Vehicles for collection- trolley, Tricycles and Rickshaws for primary collection, segregation at the site and establishment of a compost system was proposed. It was proposed to upgrade the existing solid waste dump site to a waste recovery and recycling unit with only non-recyclable residues to be landfilled.

Zone 3: Banashakari Temple Complex Precinct & Zone 4: Naganatha Kolla temple

Landscaping and environmental improvement

- Provision or up-gradation of public bio-toilet, weather shelters at adequate locations and appropriate services provision such as, anaerobic soak pits, on-situ septage treatment facility or any other appropriate environmentally friendly Sewage Treatment Plant (STP) was included in the proposal.

Zone 5: Hale Mahakuta Temple complex

Revitalization of Hosa (Old) Mahakuta temple complex and its Eco-system

- The revitalization approaches for the Hosa Mahakuta was based on understanding its natural landscape and settings and the issues they represent. Macro factors such as climate, terrain, hydrogeology, soil, flora and water played an important role in qualitative landscape interpretation. The depreciation of vegetal cover over the years in Hale Mahakuta accelerated the degradation of the soil. In order to improve the quality of the natural landscape, an integrated approach needs was proposed to be adopted which combines groundwater, soil quality and vegetation cover. There was also an urgent need to restore the water tank in the Mahakuta temple.

Improvement of the natural cover and habitat

- There was a need to halt the depreciation of vegetal cover in Hale Mahakuta which has further accelerated the degradation of the soil. Therefore, to improve the quality of the natural landscape it was proposed to protect & regenerate existing trees which help restore green cover in the surrounding valley. The landscape design considered increasing the tree cover in the site by looking at strategies such as thickets, groves, and orchards rather than the conventional and inappropriate strategies such as lawns, hedges, and exotic species and also establishing a nursery for this. Protection and regeneration of the historic trees was proposed on the sites such as the large banyan trees each about 100 years old improve the microclimate of this site. Reforestation and restoration of the natural habitat and terrain in the area which enhances wildlife was proposed.

Zone 6: Sidliphada and surrounding Forest Area with ancient walking routes

Development of nature and culture-based heritage trail

- There are several sites of natural and cultural significance near Badami which are connected to the town directly through walking trails. Badami's sandstone hills, narrow gorges and rocky landscape are part of a dry tropical thorn forest with open shrub and wild grasses landscape and pre-historic rock shelters which combine to form the unique natural heritage of this place. These trails also connect to various sites and structures of historical and architectural significance. The trek trails if properly developed can help reconnect Badami town to other significant cultural and nature-based sites. Some of these trek trails already cater to locals and nearby villages who use the existing paths during religious events. Therefore, these trails provide a holistic nature and culture-based experience to visitors, locals and trekkers. Hence, it was recommended to develop nature and culture-based heritage trails.

Agents of Change

Governemnt	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC) National Technical Committee City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Badami Municipality, District Bagalkot Badami Town Municipal Council Badami Planning Authority Bagalkot Town Development Authority (BTDA) Bagalkot Urban Development Authority (BUDA) Urban Development Department, Government of Karnataka Karnataka Forest Department Karnataka State Tourism Development Corporation Limited (KSTDC) Archaeological Survey of India (ASI) Karnataka State Archaeology Department
Private sector	Indian Heritage Cities Network (IHCN) International Council for Local Environmental Initiatives (ICLEI)
Others	Temple Trusts Local Residents Tourists

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

- The State Action Plan on Climate Change (Karnataka SAPCC) was created by the Karnataka state in the year 2011, it was again refined in the year 2021. It consists of various sectors such as groundwater, power, transport, agriculture, animal husbandry, coastal sectors and fisheries.

- Karnataka state has also prepared State Disaster Management Plan in the year 2020-2021. It encompasses various thematic areas of disaster management including Understanding the Risk, InterAgency Coordination, Preparedness & Mitigation, Disaster Risk Reduction, Capacity Development, Build Back Better Recovery, Rehabilitation and Reconstruction.

- Other than preparations of plans at the state level, there have been various attempts at the district/ city level also. The district disaster management plan, 2019-20 for Bagalkot District has been prepared with the primary purpose of coordinating responses to natural or manmade disasters and for capacity building in disaster resilience and crisis responses.

- As Badami has a moderate vulnerability level to flood and drought, a specific plan/strategy is required to manage water to prevent floods and droughts.

Gaya 7

Location
Bihar, India

Typology
City

Population
4,74,093

Bio-geographic Zone
Indo-Gangetic Plains

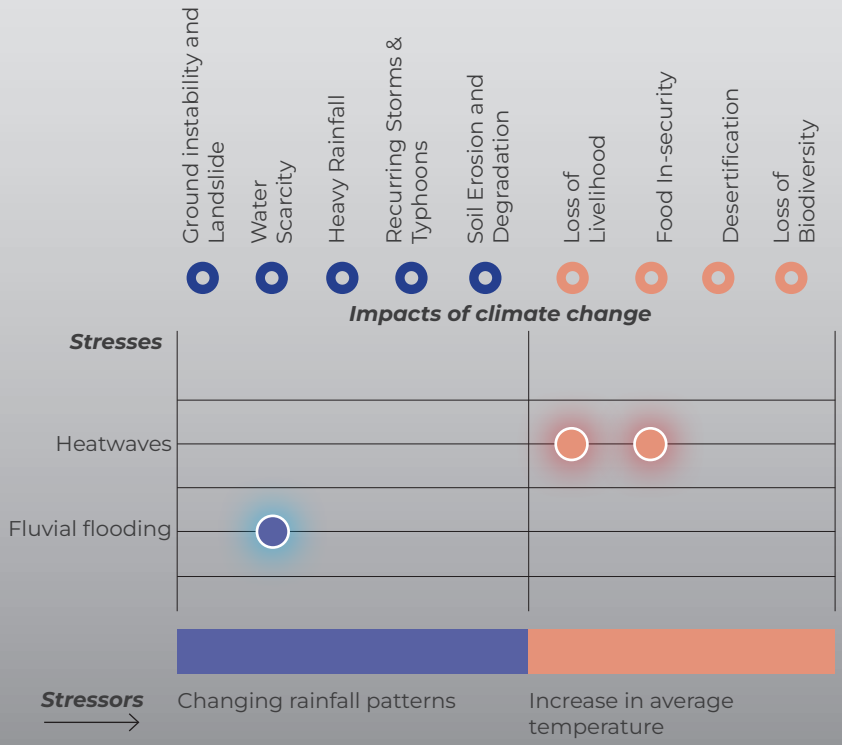
Heritage Profile

Gaya is a sacred city known for its significance in Buddhism, particularly as the place where Lord Buddha attained enlightenment and the site of the Mahabodhi Temple, a UNESCO World Heritage Site. Gaya is situated on the banks of the Phalgu River. It is sanctified by Hindu, Buddhist and Jain religions and is an important pilgrim center in Bihar due to its importance for Pinda-Dana. The area experienced the bliss of Gautam Buddha and Bhagwan Mahavir during the reign of Bimbisara.

Climate Change Profile

Impacts of climate change

- *Increase in temperature*
- *Increase in floods*
- *Change in rainfall pattern*



Nature of Responses

Demonstration projects/ Proving by doing

Zone 1: Fortified old town of Gaya- Andar- Gaya

Revival of Udyan

- Revival of Tulsi Udyan in the Vishnupad temple complex was proposed.

Development of ghats

- The proposal is to revitalize these Ghats and to make them into bigger and designed open spaces, which can be used for religious purposes during festivals and by the community as social spaces in day-to-day life. Cleaning of the Ghats by removal of debris and vegetation for all Ghats was recommended.

Solid waste management system

- Providing Dustbins at an interval of 15 m and provision of designed spaces for animals was proposed.

Improvement of public facilities

- Providing one Piyau at an interval of 1 km and three public toilets along the whole stretch was recommended.

Zone 2: The Colonial precinct on the Shree Krishna Path

Revival of the Diggi Talab

- The proposal was made to clean the Talab, remove encroachment around the Talab, and provide a boating facility, pavement, and landscaping around Talab. It also proposed about revival of the fountain of the central structure.

Zone 3: The 5 hillocks surrounding Gaya

Revive the original trail for the hills

- It was recommended to restore and repair the steps on Brahmyoni hill, Pretshilla hill and Ramshill hill.

Forestation scheme for all the hills

- Specified spaces for Smriti-Vatika on all the hills, and specified spaces for Medicine - plantation on all the hills were proposed.

Improvement of public facilities

- Providing one Piyau for every hill precinct and one public toilet for every hill precinct as well as dustbins at an interval of 15 m on the specified trail for the approach to every hill were proposed.

Zone 4: The 16 sarovars in Gaya

Plantation and landscaping

- Plantation of indigenous species on both sides of the paved entrance and landscaping of the open space around every Sarovar was proposed.

Reviving the water of every Sarovar

- Cleaning, De-silting, and Installation of filter plant.

Improvement of public facilities

- One Piyau for every Sarovar, one public toilet for every Sarovar was recommended.

Zone 5: Area from Mahabodhi temple to Dungeshwari hill

Improvement of public facilities

- Providing one Piyau at an interval of 1 km and three public toilets along the whole stretch was recommended.

Agents of Change

Government	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC) National Technical Committee City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Gaya Municipal Corporation Gaya Town Planning Authority
Others	Temple Trusts Panda families (Doing small businessmen doing business related to setting temple and pooja materials) Local Residents Tourists

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

Climate-related Concerns in Existing Plans

- The State Action Plan on Climate Change (Bihar SAPCC) was prepared by the Bihar state in the year 2015. The focus sectors identified for initiatives and interventions under the SAPCC are Agriculture along with Animal and Fishery Resources, Water Resources, Forests and Biodiversity, Health, Disaster Management, Urban Development, Energy, Transport and Industry & Mining. The approach and strategies of the SAPCC are oriented for reducing exposure, hazards and vulnerability, and building preparedness and capability for timely and effective response systems, augmenting capacity to cope with unforeseen events and for pooling and sharing of risks.

- State Disaster Management Plan was prepared in the year of 2014 which consists of two parts which include Disaster Risk Management for Perspective and on Prevention, Mitigation and Preparedness and Disaster Crisis Management for Response and Relief, 'Built Back Better' dealing with reconstruction and resettlement. Also, Gaya has District Disaster Management Plan prepared in 2022 to enable disaster-resilient and risk-informed development in Gaya district and provide services that are essential for the life and dignity of citizens during disaster and non-disaster situations.

- Other than District Disaster Management Plan, there was preparation of the Clean Air Action Plan for Gaya in the year 2020 which includes sector specific control measures for an effective plan for the city.

- Also City Development Plan prepared for 2010 to 2030 consists measures in the sector of water supply, sewerage, sanitation, storm water drainage, solid waste management and few others.

- As the vulnerability of the primary hazard i.e. drought, for the Gaya is low, it requires overall plan/ strategies to mitigate, access, and adapt to the risks.

8 Warangal

Location	Typology	Population	Bio-geographic Zone
Telengana, India	City	7,53,438	Eastern Ghats

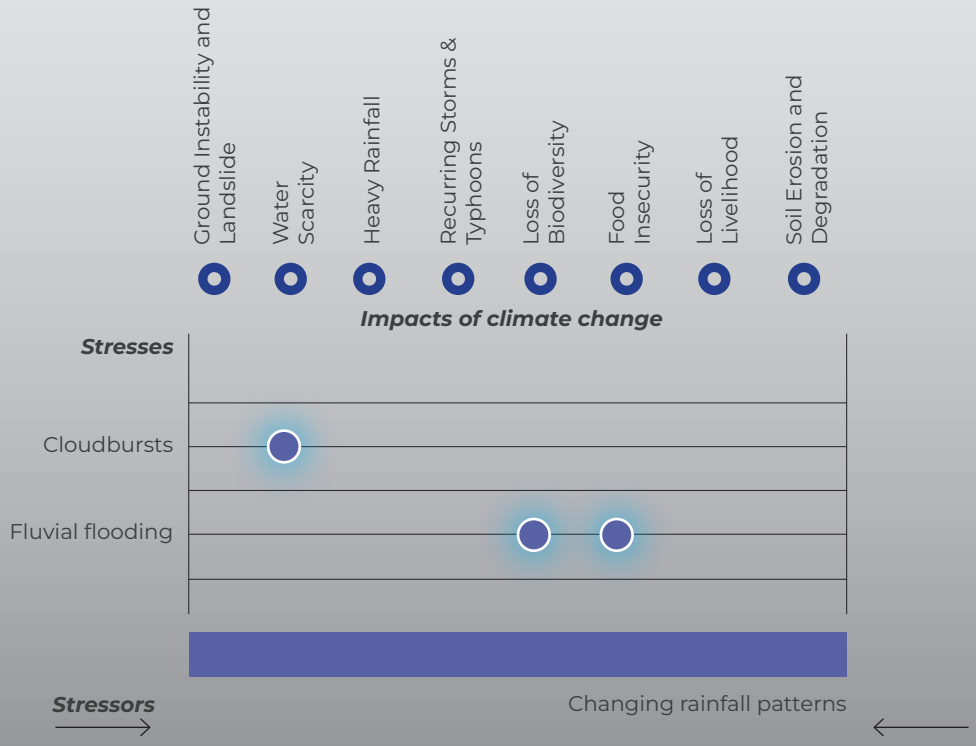
Heritage Profile

Warangal is a cluster of three towns- Warangal, Hanamkondaand & Kazipet. Warangal is Known for its Kakatiyan architecture and lakes, Warangal was ruled by Hyderabadi Nizam who strongly influenced the city's Indo-Saracenic style architecture. Warangal is renowned for its rich historical heritage, including the iconic Thousand Pillar Temple and the majestic Warangal Fort.

Climate Change Profile

Impacts of climate change

- *Increase in floods*



Nature of Responses

Demonstration projects/ Proving by doing

Zone 1: The Bhadrakali temple and lake precinct

Delineating the boundary for the park & protection of hills

The proposal was made to provide green cover along the hills by delineating the green boundary providing trees and open spaces along the hills near the neighbourhoods and providing the neighbourhood level parks.

Connecting Bhadrakali temple and hillocks

Proposal of a cantilever pedestrian bridge over the lake at the end of the promenade of the Bhadrakali temple connecting to the hillocks was made.

Redevelopment of the Padmakshi temple precinct

Reviving the Padmakshi tank providing the ghats for the pond was propsoed.

Protection of Biodiversity

Protection of the open lands, small water bodies, providing breeding islands, viewing decks along the lakes, encouraging thick plantations with indigenous trees and plants was proposed.

City Level Proposals

Open spaces

- Proposing a city-level open space in the bio-diversity & cultural park was done.
- Protection of the lake within the city by making them into the city-level & neighborhood-level public spaces was recommended. Protection of the water bodies outside the city by defining them with green cover was also included.
- Providing green networks in the form of open spaces, lines of tress and small green areas to connect heritage areas through augmentation of open spaces was recommended.

All Zones

Tourist Infrastructure projection

- Provision of public toilets, drinking water stations, changing rooms, tourist information kiosk was proposed.

Policy regulations and Statutory measures

Zone 4: Waddepally Lake and surroundings

Regulating the development around the lake

- Delineating the boundary of the lake and stopping the encroachments into the lake, Implementing the no development zone for saving the lake and various agricultural lands and save the bio-diversity of the lake, Regulating the land use along the lake and encouraging more public-oriented activities within the lake precincts.

Agents of Change

Governemnt	Ministry of Housing and Urban Affairs National Institute of Urban Affairs (NIUA) National Advisory Committee (NAC) HRIDAY National Empowered Committee (HNEC) National Technical Committee City Level Advisory and Monitoring Committee (CLAMC) City Mission Directorate Ministry of Housing and Urban Affairs (MoHUA) Kakatiya Urban Devlopment Authority, Warangal Archaeological Survey of India (ASI) Telangana State Archaeology Department
Private Sector	Indian National Trust for Art and Cultural Heritage (INTACH) Architecture Division
Others	Temple Trusts Local Residents Tourists

Funding Source

HRIDAY Scheme- Ministry of Housing and Urban Affairs, Government of India

- The State Action Plan on Climate Change (Telangana SAPCC) was prepared by the Telangana state in the year 2015. Major climate change issues for the State arise in the agriculture and forestry sectors and in relation to droughts and heat waves. The focus sectors identified for the projects and strategies are Agriculture and allied sectors, Forestry and biodiversity, Energy, Industries (including mining), Transportation, Health, Urban development, Tourism and Rural Development. Research or knowledge development on climate change specific to Telangana has also been identified as a sector which should be developed to support data on mitigation and adaptation for the other sectors.

- As the primary hazards are droughts and heatwaves, Telangana state has prepared Telangana State Heatwave Action Plan in the year 2019. It aims to provide a framework for developing plans for the preparedness, implementation, interagency coordination and impact evaluation of heatwave response activities in all the districts that reduce the negative impact of extreme heat. The state has also prepared Telangana State Disaster Management Plan to mitigate and adapt the risks.

- Other than state level, various plans have been prepared at the city/ district level which include climate change concerns. City Development Plan for Warangal, prepared in 2011 has sectors water supply, sewerage, sanitation, storm water drainage, solid waste management and transport also. Also Master Plan for Warangal has various segments related to climate change which includes protection of lake and natural assets, protection of heritage areas and tourism.

- As the vulnerability level is moderate for flood and drought, it requires specific plan for heatwaves and flood at the city levels as well for their respective issues and challenges.

Annexure 3

Navigating Case Studies: A Step by Step Guide

This step by step guide has been designed to search case studies through three parameters which are stressors, stresses and impacts. It also allows to select multiple sub categories of these parameters. Permutation and combination of these parameters will help in navigating to specific case studies.

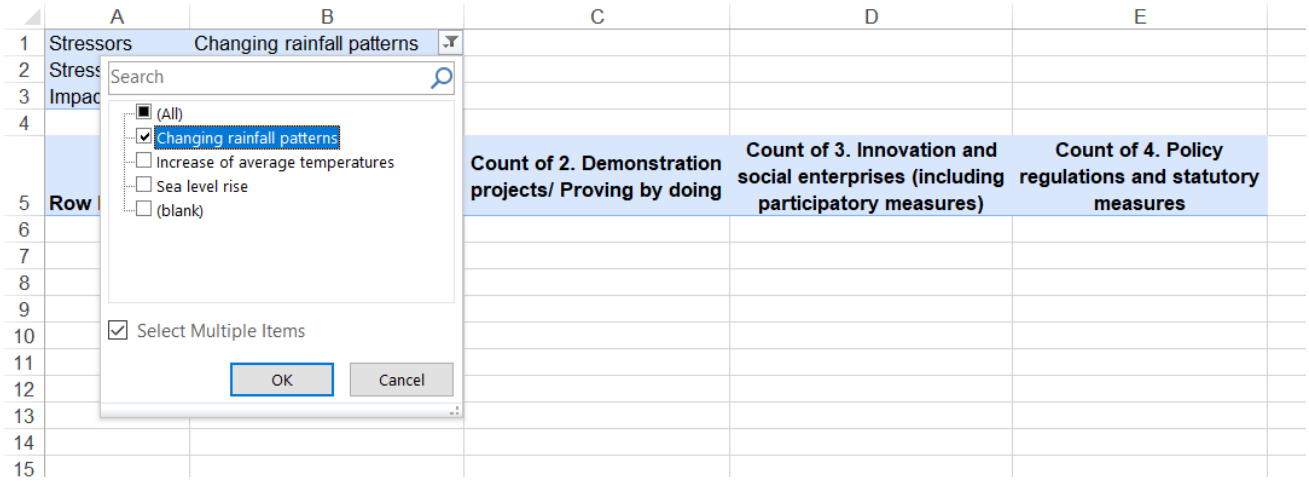
Scan to access the case study Database

Step 01:

	A	B	C	D	E
1	Stressors	(blank)			
2	Stresses	(blank)			
3	Impacts	(blank)			
4					
5	Row Labels	Count of 1. Information and Advocacy	Count of 2. Demonstration projects/ Proving by doing	Count of 3. Innovation and social enterprises (including participatory measures)	Count of 4. Policy regulations and statutory measures
6	(blank)				
7					
8					
9					
10					
11					
12					
13					
14					
15					

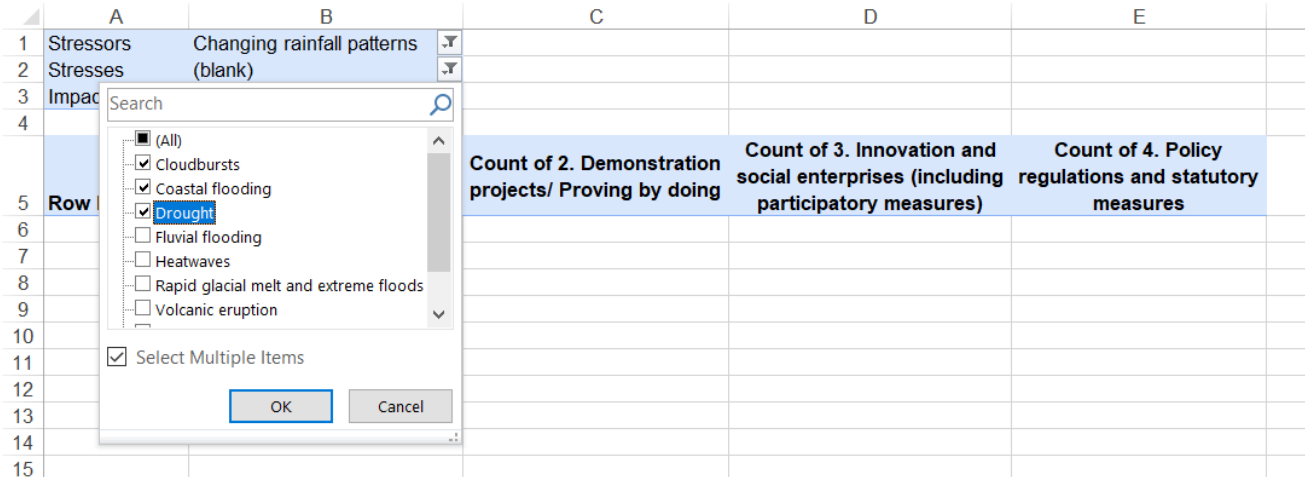
When you open the excel database of case studies, try to categorize your Stressors, Stresses and Impacts in your city and apply them in the filters available.

Step 02:



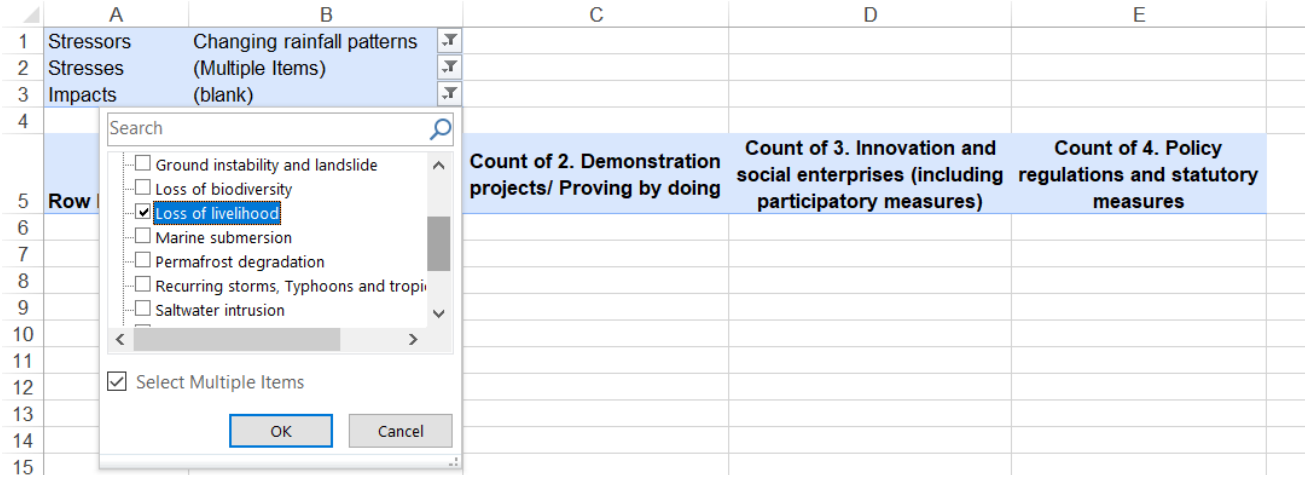
Based on the stressors you are facing your city, you can enter one or multiple stressors of the three available stressors in the filter. Once selected, click 'OK' to record your response.

Step 03:



Once you are done selecting the Stressors, Click on the drop down box for selecting Stresses and select one or multiple Stresses that your city is facing and click 'OK' to record your response.

Step 04:



Once you are done selecting the Stresses, Click on the drop down box for selecting Impacts and select one or multiple Impacts that your city is facing and click 'OK' to record your response.

Step 05:

Stressors	Changing rainfall patterns
Stresses	(Multiple Items)
Impacts	(Multiple Items)

Row Labels	Count of 1. Information and Advocacy	Count of 2. Demonstration projects/ Proving by doing	Count of 3. Innovation and social enterprises (including participatory measures)	Count of 4. Policy regulations and statutory measures
George Town, Penang	•	•	•	•
Jheels - Virdas of Banni Grasslands		•	•	
The Chauka System of Rajasthan		•	•	

Once you have recorded the three parameters, you will find a list of all the case studies which face the same issues as yours from all around the world. You will also find nature of respones for all the case studies.