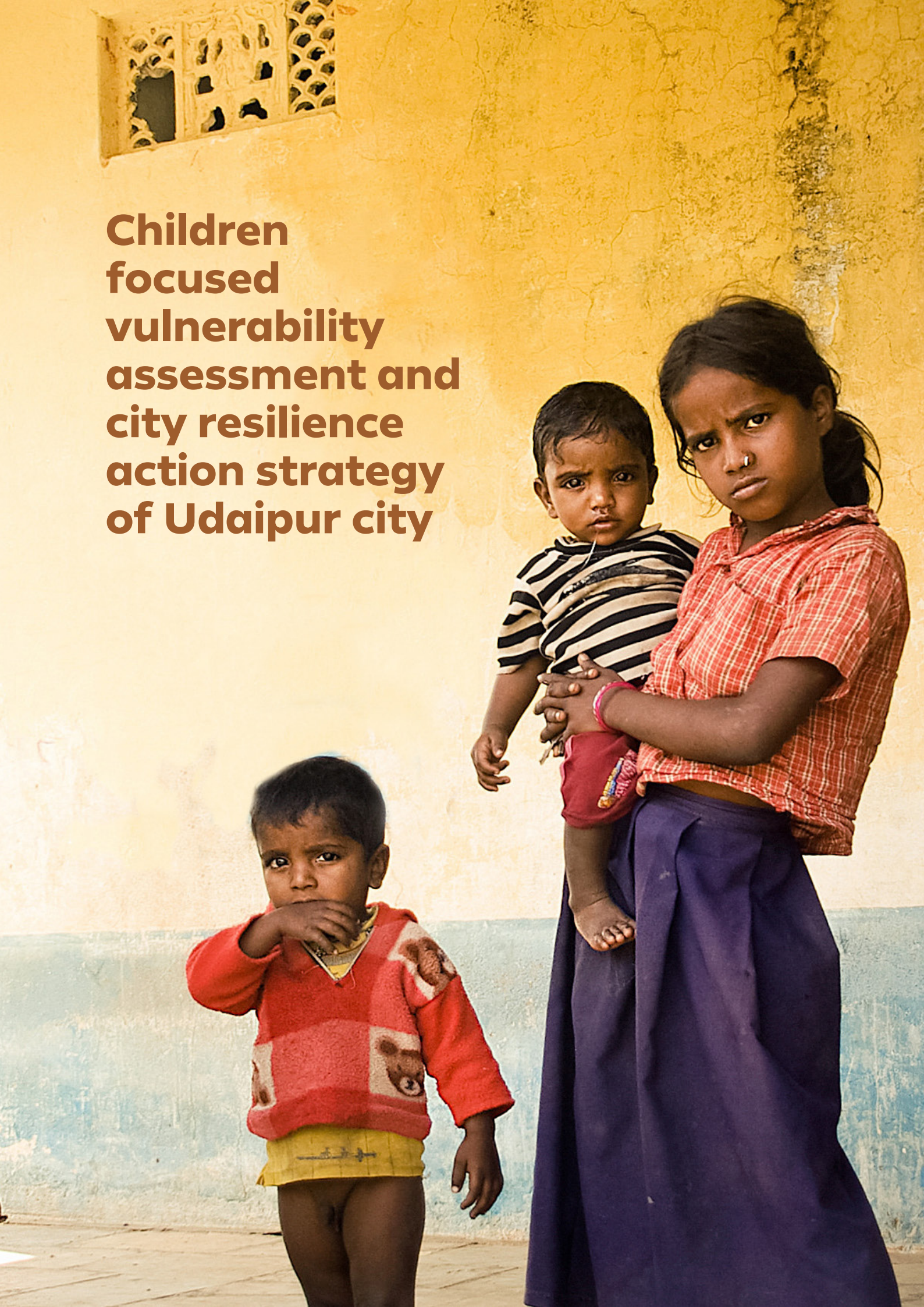
Children focused vulnerability assessment and city resilience action strategy of Udaipur city



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Contents

List of Boxes, Figures, Maps and Tables

Boxes

Figures

Maps

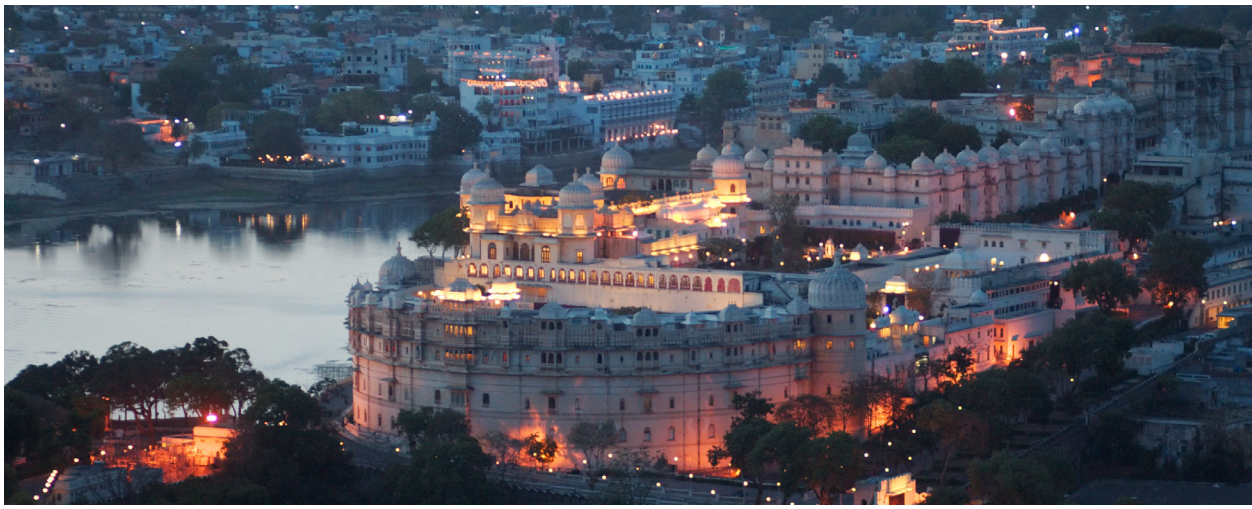
Tables

Abbreviations

ABD	Area Based Development
ACCCRN	Asian Cities Climate Change Resilience Network
AMRUT	Atal Mission for Rejuvenation and Urban Transportation
CAA	Constitutional Amendment Act
CDP	City Development Plan
CLD	Causal Loop Diagram
CRF	Climate Resilience Framework
CRS	City Resilience Strategy
CSO	Civil Society Organization
CSP	City Sanitation Plan
CSR	Corporate Social Responsibility
DRR	Disaster Risk Reduction
DIET	District Institute of Education and Training
ETP	Effluent Treatment Plant
FGD	Focussed Group Discussion
GEAG	Gorakhpur Environmental Action Group
IMD	India Meteorological Department
IMR	Infant Mortality Rate
INGO	International Non-Government Organization
ISET	Institute for Social and Environmental Transition
LPCD	Litre per Capita per Day
MLD	Million Litres per Day
MMR	Maternal Mortality Rate
MoUD	Ministry of Urban Development
NAPCC	National Action Plan on Climate Change
NGO	Non-Government Organization
PHED	Public Health and Environmental Engineering Department
PMAY	Pradhan Mantri Awas Yojana
RCM	Regional Climate Modelling
RSAPCC	Rajasthan State Action Plan on Climate Change
RSDMP	Rajasthan State Disaster Management Plan
SAPCC	State Action Plan on Climate Change
SCERT	State Council of Educational Research and Training
SFDRR	Sendai Framework for Disaster Risk Reduction
SLD	Shared Learning Dialogue
STP	Sewerage Treatment Plant
SWM	Solid Waste Management
TDS	Total Dissolved Solid
TPD	Tonnes per Day
UCCR	Urban Climate Change Resilience
UIT	Urban Improvement Trust
ULB	Urban Local Body
UMC	Udaipur Municipal Corporation
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WFPR	Work Force Participation Rate

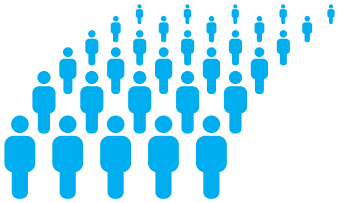
CHAPTER 1

Introduction



In this modern and urbanising world about 54.5 per cent of the world's population live in urban settlements (UN, The World's Cities in 2016). The world's urban population is expected to increase by more than two thirds by 2050 and nearly 90 per cent of this increase will take place in urban areas of Africa and Asia (UN, World Urbanisation Prospects: The 2014 Revision, Highlights). With regards to South Asia, it is estimated that almost 250 million people will be added to the existing population by 2030. A key concern for South Asia's urbanisation process is the "*Messy and Hidden*" nature of urbanisation. The widespread existence of slums and sprawls leads to messy urbanisation, specifically on the peripheries of major cities which is often not captured in the official statistics. Hidden urbanisation can also be seen, as a larger proportion of the population of the region is living in settlements possessing urban characteristics but do not satisfy the criterion to be officially classified as urban (Ellis and Roberts, 2016).

Likewise South Asia, a messy and hidden trend of urbanisation is observed in the Indian cities with inadequate provisioning of infrastructure and basic urban services, increasing pressure on land and degradation of the environment. India has witnessed



Around 250 million people will be added to South Asia's existing population by 2030

unprecedented urbanisation between 2001 and 2011. Census of India, 2011 reveals that the level of urbanisation increased from 27.81 per cent in 2001 Census to 31.16 per cent in 2011 Census and the proportion of rural population declined correspondingly from 72.19 per cent in 2001 to 68.84 per cent in 2011 (Chandramouli, 2011). Around 13.7 million slum households are there across India with 63 per cent of the statutory towns being home to these settlements (Census of India, 2011). The 400 odd cities of India and numerous small towns which are home to about India's two third urban population offering employment opportunities and livelihoods are the key centres of attraction for migration, despite inadequate and unreliable physical infrastructure in terms of housing, drinking water supply and drainage (Bhat, et al., 2013).

The process of urbanisation is common across the country, but the urban areas are highly varied and at this point of time where the concept of 'Smart City' puts an official mandate for sustainable and inclusive development of cites, some specific challenges need to be addressed. Acclimatizing a doubling of urban population while addressing the social and environmental pressures (urban spatial expansion, improving infrastructure and access to services and transportation) which accompany the process of urbanisation and economic growth should become a policy priority (OECD, 2014).

1.1 Climate change and cities

With rapid and unplanned urbanisation and increasing poverty, the cities across the globe are grappling with the biggest development challenge of climate change. With continued global warming, the year 2016 was marked the third year in a row that set the record for the highest global temperatures. Without even doubling the CO_2 concentration, we have already halfway crossed the 2-degree mark[1]. There is a common global consensus that climate change will increase the frequency of droughts, floods and severe weather events. Slow-onset climate change impacts can also undermine development gains and livelihood options (Unless we act now, UNICEF, 2015).

In India, climate change is now being increasingly linked to urban concerns as it is expected to exacerbate the risks in the infrastructure/resource deficit urban environments across the country. Socio-economic losses of climate change are already visible with large-scale losses of infrastructure and properties during disasters, widespread vector and water-borne diseases, loss of livelihoods and decreasing food security etc. Rapidly developing second- and third-tier cities are altogether more vulnerable to climate change impacts due to their limited infrastructural and institutional capacities, constrained finances and growing population.

The hydro-meteorological risks in the cities are expected to be amplified by climate change with more and more people exposed to the additional risks. These risks have different impacts on different sections of the society where some are able to afford mitigative, coping and resilience measures, while some are exposed to higher risks with little or no protective measures (Bhat, et al., 2013). A resilient and inclusive city approach is required for Indian cities where the infrastructure and the urban systems can withstand the stresses and extreme weather events and thereby reducing the vulnerabilities of men, women and children.

1 'Climate change in 2016: the good, the bad and the ugly', The Guardian, 2 January 2017, <www.theguardian.com/environment/climate-consensus-97-per-cent/2017/jan/02/climate-change-in-2016-the-good-the-bad-and-the-ugly>, accessed 23 October 2017.

1.2 Urban children in a changing climate: Global and Indian context

Children, especially the younger ones are not well-prepared to face deprivation and stress. With immature organs, rapid metabolisms and limited experience, they are more likely to get exposed to various risks than adults (Bartlett, 2008). Over half a billion children of the world are living in extremely high flood occurrence zones and around 160 million are living in high or extremely high drought severity zones (Unless we act now, UNICEF, 2015). While in every crisis children are the most vulnerable, but the urban children are at a higher risk where the concept of "*urban advantage*" (Bartlett, 2008; Van de Poel, et al., 2007) does not hold good for those living in poverty, with lack of education and life opportunities. Children may face the immediate impacts of climate change where access to basic facilities like clean water, sanitation, health and education will become difficult. Extreme weather events can destroy or disrupt the infrastructure critical to children's well-being, including schools, health facilities and transport. They may have to face challenges where they have to cope up with higher levels of conflict and other types of pressures which will force them to leave schools early and do work too soon (Back and Cameron, 2008).

India, the largest democracy in the world is also home to the largest number of children in the world (The Situation of Children in India: A Profile, UNICEF, 2011). Child population in the age group of 0-6 years stands for 164.5 million, out of which 43.2 million are in the urban areas (India National Health Profile, 2016). An appalling fact is that more than 8 million children under 6 years of age live in slums (Forgotten Voices, Save the Children, 2015). Cities and towns in India are increasingly becoming vulnerable to the effects of natural disasters and climate extremes. The urban poor children in India, those living in low-income settlements, slums and streets, those who are orphans or have a physical disability are the most vulnerable ones with poor access to health, water, sanitation, education and physical safety and protection.

Disasters directly affect the children by causing deaths, injuries, diseases and malnutrition and these conditions are exacerbated by secondary disasters and climate change (Lawler, 2011). The cases of trafficking, exploitation and other kinds of child abuse are also observed in the aftermath of disasters increasing the vulnerability of children (Child centred DRR in South Asia, UNICEF, 2015). Climate change is expected to accelerate large-scale environmental changes like desertification, diminishing freshwater resources and biodiversity loss which will have long-term impacts on child health and well-being (Goodman, et al., 2008).

Children have the same right to survival, education, safety, clean water, health, sanitation, shelter and protection during and after disasters as they have before the disasters. Before it's too late we have the opportunity to inculcate the concept of 'Child-friendly resilient cities' in our current development process with the right governance structures and adequate investment for inclusive growth. The 'Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030' very clearly gives the message of this inclusive development where children and youth are identified as "*Agents of Change - Children and youth are agents of change and should be given the space and modalities to contribute to disaster risk reduction.*" The 12 Sustainable Development Goals also directly or indirectly relate to the interests of children. We need to gradually expand our aims and objectives beyond school safety and education, keeping in mind the multi-dimensional vulnerability strongly emphasising on child rights and child participation.

CHAPTER 2

State of Rajasthan: Key challenges of urbanisation

Rajasthan, also known as the "*Land of Kings*" is the largest state of India covering an area of 342,239 km^2 (RSDMP, 2014). Encompassing 10 per cent of the total geographical area of India, the state is home to 68 million people, out of which 50 per cent are under the age of 18 years (Census of India, 2011). With 75 per cent of its population living in villages, the state is predominantly rural. Around 17.8 per cent population belongs to scheduled caste and 13.5 per cent belongs to scheduled tribes[2]. An important trend to be observed is the growth of urban population at a relatively faster rate with Compound Annual Growth Rate of 3.19 per cent, which is more than the national average (Draft Rajasthan Urban Development Policy, 2015:1). With increasing urbanisation, many social, economic, environmental and cultural transformations are occurring in the urban centres and keeping pace with the predicted continuing growth is a challenge for the state.

The state has only 1 per cent of the country's water resources to support 10 per cent of the total geographical area and 6 per cent of the total population of the country

2 'About Rajasthan', UNICEF Rajasthan, <http://unicef.in/StateInfo/Rajasthan/Introduction>, accessed 24 October 2017.

Urban water supply is one of the most strident problems faced by the state of Rajasthan. The state has only 1 per cent of the country's water resources to support 10 per cent of the total geographical area and 6 per cent of the total population of the country (RSDMP, 2014). Per capita water availability is 1000 m^3/year which is below the national average of 1903 m^3/year (RSAPCC, 2010). Another major issue is the diminishing quality and quantity of surface and groundwater resources with declining groundwater levels by more than 4 metres and a higher percentage of saline affected areas over the state (ibid:1). Other key challenges of urbanisation in Rajasthan are summarised in the Box 1.

Box 1: Key challenges of urbanisation - Rajasthan

Urban Transport: Lack of integration of transport plan with land development plan has led to unplanned and unregulated land-use. Due to lack of efficient public transport system, problems like traffic congestion, parking shortage, pollution and road accidents etc. are increasing.

Stormwater Management: The overall planning process of urban areas neglects the stormwater drainage systems. The regional development plans, master plans and zonal plans fail to take into account the natural water flow which becomes the part of the built environment.

Solid Waste Management: Total solid waste generated in the state is 5,037 Tonnes Per Day (TPD), out of which 2,491 TPD is collected and only 490 TPD is treated. The waste is disposed in an unscientific manner. Management of increasing bio-medical waste is another major issue where 25 per cent of the waste is left untreated and not disposed of properly.

Affordable Housing: The effect of growing population has been felt the most in the housing sector. There is a substantial lack of housing and basic infrastructural services as compared to supply. The key causes are lack of adequate finances, lack of planning capacity and inability to implement land-use plans, lack of coordination by local authorities and other service delivery companies to implement the land-use plans and inability of planning and local authorities to enforce planning and building regulations resulting in an uncontrolled development.

Slums: According to 2011 Census, the state has 185 statutory towns out of which 107 are slum reported towns. The total slum population living in identified slums is 2,068,000. This poorest segment of the society has limited or no access to basic services and has no security of tenure. There is a lack of municipal finances for slum up-gradation and shelter development programmes.

(Source: Compiled from 'Rajasthan Urban Development Policy, 2015-Draft')

2.1 Climate change impacts on Rajasthan

The climate of Rajasthan varies from arid to semi-arid. The average summer temperature ranges from 25° to 46° C. During hypothermic conditions in the state, the temperature may rise up to 49° C. The average winter temperature ranges from 8° to 28° C which drops to -2° C creating wind-chill effects in some parts of the state. The average rainfall of the state is 531 mm, far below the national average of 1200 mm (RSDMP, 2014). Future climate projections and analysis of the regional climate models reveals that the mean annual rainfall is expected to decrease slightly, but the extreme rainfall is expected to increase in frequency and intensity.

Due to severe impacts on sectors like agriculture, animal husbandry, water resources, forests, biodiversity and human health, the state is characterized by high climate sensitivity. Changes in the precipitation pattern may increase the likelihood of short-run crop failures and production declines. Increasing temperature leading to heat stress may adversely impact the productive and reproductive performance of dairy animals. The health sector will be adversely affected by increasing risks of vector, water and food-borne diseases, aggravating malnutrition and increasing injuries and deaths from extreme rainfall events and thermal stresses (RSAPCC, 2010).

Rajasthan is a water deficit state with depleting surface and groundwater resources. Scanty and irregular rainfall will further slow down the process of groundwater recharge. "*Total available*

utilizable groundwater for Rajasthan is 11159 mcm and the increase of 1 % in temperature will put an additional stress of 6.43 to 20.16 % on the existing groundwater resources" (CDP, Udaipur, 2014). Climate change will lead to more recurrent droughts in 3–4 years in a cycle of 5 years in Rajasthan.

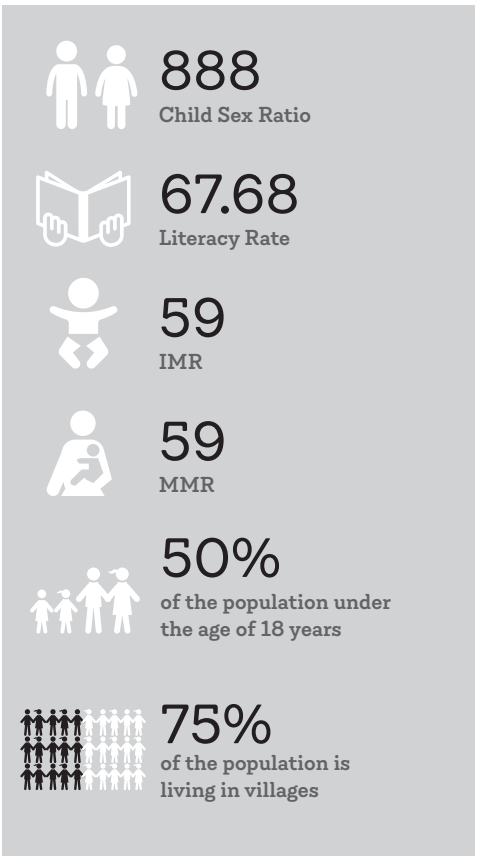
According to Rapid Survey on Children-2014, 23.8 per cent of children in urban Rajasthan aged 0-59 months are underweight. Around 7.6 per cent urban children in the same age group are severely underweight. Globally, it has been found through research studies that droughts have long-term impacts on malnutrition in children. Children aged 5 or under are more likely to be malnourished if they were born during a drought. Intense rainfall after a long period of drought will cause more severe multiple disease outbreaks. The chances of rodents and rodent-borne diseases increase when droughts are followed by floods (Tibbetts, 2007). All these processes affect the children by causing lack of food, safe drinking water, increased risks of diseases and disturbing their daily routine life causing mental trauma.

2.2 Children in mainstream policies of Rajasthan

2.2.1 Rajasthan State Action Plan on Climate Change, 2010

The Rajasthan State Action Plan on Climate Change (RSAPCC) envisions the state "*to achieve sustainable development by reducing vulnerability to climate change impacts and enhancing the resilience of ecological, economic and social systems in Rajasthan*". An analysis of RSAPCC reveals that the state recognises the specific vulnerability of children to climate change impacts but not all the strategies articulated in the plan are considering children specifically. Gender-based impacts of climate change on children are not discussed in the plan but it identifies the existing gender bias and disparity on account of sex and caste in the society. Rajasthan has the lowest literacy level among girls in the country which is identified as a barrier to health awareness and use of the available health services and schemes.

Box 2: Rajasthan-Facts



(Source: UNICEF Rajasthan)

Children are given due importance in the health sector of RSAPCC and their specific vulnerabilities due to climate change are identified. The key issues identified for health sector are: high Infant Mortality Rate (IMR), Maternal Mortality Rate (MMR), malnutrition among children and women, high incidence of childhood diseases, child marriage, declining sex ratio of girls under six years, low female literacy in comparison to national average, inadequacies in water supply and sanitation, poor health and poor socio-economic status of women along with social discrimination.

Droughts in western Rajasthan are identified as serious threats to the well-being of children under 5 years of age causing an inadequate intake of daily food leading to respiratory, gastroenterological and calorie and protein deficiency among a large proportion of children.

The following goals of the Public Health sector of RSAPCC are also directly/indirectly related to children's health, education and protection: reduction in IMR and MMR, arresting gender imbalance, restructuring of health care delivery system, human resource development and capacity building and decrease the burden of diseases and promote a healthy lifestyle.

2.2.2 Rajasthan State Disaster Management Plan, 2014

The plan identifies women and children as vulnerable groups of society who are exposed to higher risks. It puts emphasis on building the capacities of women so that the "*special needs*" of women and children are taken care of during and after disasters. The plan provides various administrative/delivery mechanisms to integrate Disaster Risk Reduction (DRR) in national and state schemes while catering to the special needs of women and children. The plan promotes gender equality in DRR through political, social, economic, scientific, technical and humanitarian approaches.

Climate change is also an integral part of the disaster management policy with a mention of state- specific climate mitigation strategies. Extreme climate and climate change are identified as risk enhancing or perpetuating factors but the impacts of climate change on children are not discussed in the plan.

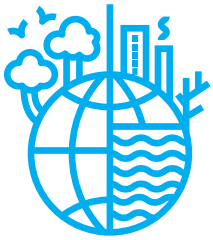
CHAPTER 3

Resilience concepts

This section of the document outlines the theoretical and analytical concepts that frame the basic idea of Urban Climate Change Resilience (UCCR). It also talks, in brief, the guiding principles and the key characteristics of UCCR.

3.1 Urban climate change resilience

In the context of the work on climate change, development and natural hazards, resilience is generally understood as the ability of systems to "*absorb disturbance and re-organize while undergoing a change so as to still retain essentially the same function, structure, identity and feedbacks.*"[3] There are numerous definitions of urban resilience. Some argue that "*a resilient city is the one that can adapt to changing conditions and withstand the shocks while still providing essential services to its residents*".[4] Others argue with a stand on a vision for resilience that includes ideas of taking advantage of



Resilience is the capacity of individuals, communities, institutions, businesses and entire systems to survive, adapt and thrive in the face of chronic stresses and acute shocks and even transform when conditions require it

3 C. Folke. 2006. Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses. *Global Environmental Change*. 16 (3). p. 259.

4 World Bank. 2014. Can Tho, *Vietnam: Enhancing Urban Resilience*. Washington, DC.

opportunities and bouncing back better.[5] For example, "*Urban resilience is the capacity of cities to function so that the people living and working in cities—particularly the poor and vulnerable—survive and thrive no matter what stresses or shocks they encounter.*"[6]

These definitions of urban resilience further branch out into an understanding of UCCR, which adds specificity to the nature of shocks and stresses and includes those that have hydro-meteorological origins. UCCR embraces climate change adaptation, climate change mitigation and disaster risk management while recognizing the complexity of rapidly growing urban areas and uncertainty associated with climate change.[7]

This approach of understanding UCCR concept also emphasizes on considering cities as dynamic systems, which are capable of evolving and adapting to the threats posed by climate change shocks and stresses. Systems thinking approach also helps in working across sectoral silos and engaging with multiple and evolving risks, simultaneously.[8] This is important because climate change is increasing the frequency and intensity with which climate shocks and stresses occur, rendering historical records alone less effective in predicting the future. Importantly, the resilience of a city depends on the overall performance and capacity of its systems, not solely on its ability to manage disaster risk, reduce greenhouse gas emissions, or adapt to the impacts of climate change. In fact, UCCR describes a city that is resilient on three levels:

1. The city's systems survive climate-related shocks and stresses.
2. The people and organizations are able to accommodate climate-related shocks and stresses into their daily decisions.
3. The city's institutional structures continue to support the capacity of people and organizations to fulfil their aims.

3.2 Key frameworks for UCCR

There are a number of frameworks, which have been formulated on UCCR and these have emanated from the experiences of different organisations across the globe. Though these frameworks have been developed in different contexts, there is a high degree of convergence that can be seen which is mainly because the concept of UCCR engages a wide range of issues. Each of these frameworks commonly highlights that integration of technological advancements and infrastructural growth along with engagement with organisational, social, institutional and financial issues is essential to make cities resilient.

3.2.1 City Resilience Framework, Arup[9]

Arup's City Resilience Framework developed with the support of The Rockefeller Foundation is designed to enable the cities to measure and monitor the multiple factors that contribute to their resilience. The City Resilience Index, as it is called, presents a view of what a resilient city looks like and represents an outcome-oriented framework, with 12 outcomes across four different categories (health and well-being, economy and society, infrastructure and environment and leadership and strategy) and 7 additional qualities of resilience (integrated,

5 D. Satterthwaite et al. 2007. Building Climate Change Resilience in Urban Areas and among Urban Populations in Lowand Middle-income Nations. Background paper for the Rockefeller Foundation's Global Urban Summit Innovations for an Urban World. Bellagio. July; J. da Silva, S. Kernaghan and A. Luque. 2012. A Systems Approach to Meeting the Challenges of Urban Climate Change. *International Journal of Urban Sustainable Development*. 4 (2). pp. 125–145.

6 ADB. 2014. *Urban Climate Change Resilience: A Synopsis. Manila*.

7 J. da Silva, personal communication, 24 August 2015

8 B. Walker and D. Salt. 2006. *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington, DC: Island Press; L. H. Gunderson and C. S. Holling. 2001. *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington, DC: Island Press.

9 City Resilience Index, ARUP. https://www.arup.com/perspectives/themes/cities/city-resilience-index, Accessed 14 November 2017

inclusive, resourceful, flexible, redundant, robust and reflective), resulting in 52 indicators. Therefore, in this framework, 'resilience' implies an enhancement to city systems capacity to function in the face of multiple hazards.

3.2.2 Urban Climate Change Resilience Framework, Institute for Social and Environmental Transition (ISET)-International

The Climate Resilience Framework (CRF) developed by ISET-International is a conceptual planning approach to building resilience to climate change, which results from dynamic interactions between three elements:

1. **Systems**: infrastructure, ecosystems, water and food supply, energy, transport, shelter and communications
2. **Agents**: individuals, households and private and public sector organizations
3. **Institutions**: laws, policies, social and cultural rules or conventions that structure human behaviour and exchanges in social and economic interactions, including rights and entitlements, decision-making processes (particularly in relation to urban development) and access to information and knowledge

It operationalized these concepts through structured and iterative-shared learning approaches that allow local planners to define these factors in their own context, in order to develop practical strategies for local action.

3.2.3 City Resilience Framework, Asian Cities Climate Change Resilience Network (ACCCRN)

The framework developed for ACCCRN, pioneered by The Rockefeller Foundation, views the city as a sum of interconnected parts that share dynamic relationships and argues that urban systems, vulnerable groups and climate change combine to determine the resilience of a city. This means that anyone designing or deploying actions to build resilience should consider three main aspects: how does the city work, direct and indirect impacts of climate change on cities and who is least able to respond to climate-related shocks and stresses.

3.3 Key characteristics of UCCR

Urban resilience to climate change demands that key actors develop and demonstrate a set of core capacities and that city systems exhibit a number of essential characteristics. These characteristics (Table 1) of resilience can be used to group and conceptualize a set of systemic behaviours that avoid catastrophic outcomes or system breakdown and enable recovery and stability after dramatic and unexpected events or gradual impacts that force change over time. Each of the characteristics is applicable to the infrastructure, institutional and knowledge networks that comprise the urban system.

Table 1: Key characteristics of UCCR

Flexibility: It is the ability to change, evolve and adopt alternative strategies (in either short or the long term) in response to changing conditions. Flexibility implies recognizing when it is not possible to return to the previous way things worked and finding new solutions and strategies (evolution). This favours 'soft' rather than 'hard' solutions.	**Safe failure:** Resilient network infrastructure is designed for safe failure. This is related to its ability to absorb shocks and the cumulative effects of slow-onset challenges in ways that avoid catastrophic failure if thresholds are exceeded. When a part of the system fails, it does so progressively rather than suddenly; with minimal impact on other systems. Failure itself is accepted.
Redundancy: It is the spare capacity to accommodate increasing demand or extreme pressures. Redundancy is about diversity and the ability to adopt alternative strategies through the provision of multiple pathways and a variety of options. Some components of the urban system serve similar functions and can provide substitute services when another component is disrupted.	**Responsiveness:** It is the ability to re-organize, to re-establish function and sense of order following a failure. Rapidity is a key part of responsiveness in order to contain losses and avoid further disruption. However, such rapidity of response should not impair the capacity to learn and therefore a balance between learning and rapidity should be achieved.
Resourcefulness: It is the capacity to visualize and act, to identify problems, to establish priorities and mobilize resources when conditions exist that threaten to disrupt an element of the system. This capacity is related to the ability to mobilize assets (financial, physical, social, environmental, technology, information) and human resources to meet established priorities and achieve goals.	**Learn:** Direct experience and failure play a key role in triggering learning processes. Individuals and institutions should have the ability to internalize experience and failures and use such experience to avoid repeating past mistakes and exercise caution in future decisions.

CHAPTER 4

Methodology

The methodological framework followed a set of key steps which aimed at understanding the existing and future risk profile of the city based on the shocks and stresses which the city faces and its' vulnerability, specifically on children and vulnerable groups. It was determined by the local factors of the city and resilience strategy/actions were prepared for the same. The focus of the assessment is to facilitate adaptation initiatives and mainstream them into the city development paradigm to make the city more resilient and prepared towards the risks.

This assessment is done through the following steps:

4.1 Literature review

A range of resilience frameworks as mentioned in the previous section, which are internationally established were studied and used to develop the methodology and approach of the CRS. The first step was to assess the current literature linking urbanisation, climate change, urban poverty and the status of urban poor children in Udaipur city. This drew heavily upon recent commissioned research into these areas like: previously conducted

A participatory and bottom-up evidence-based research approach was adopted to identify the children specific vulnerabilities in the city

vulnerability assessments of infrastructure and systems in the city, City Development Plan of Udaipur (CDP), City Sanitation Plan of Udaipur (CSP), Master Plan of Udaipur, Report of the Udaipur Municipal Corporation (UMC), Rajasthan State Action Plan on Climate Change (RSAPCC) and Rajasthan State Disaster Management Plan (RSDMP) etc. In addition, climate data projections for Udaipur city was also done based on the historical data to predict the future probable impacts of climate change. Review of existing policies and governance framework of the city was also done to identify channels for integrating adaptation and DRR measures. Secondary data and information were also collected.

4.2 Policy review

In India, the primary tool for climate change planning is the State Action Plan on Climate Change (SAPCC). Most states, including Rajasthan, have their SAPCCs, which describe the climate change projections and risks for the state and list the priority actions that the State Government proposes to undertake to adapt to climate change and to contribute to reducing global greenhouse gas emissions. The Government of India has launched a plan with certain missions called National Action Plan on Climate Change (NAPCC) in the year 2008. The plan provides an accurate focus on the needed interventions. The NAPCC consists of many targets on climate change problems and addresses the urgent and important issues of the country through a directional shift within the development pathway. It had given directions of measures on climate change-related adaptation and mitigation whereas at the same time advancing development. The Missions form the core of the plan, represent multi-pronged, long-term and integrated ways for achieving goals within the context of climate change. Presently, NAPCC is enforced through eight National Missions. These Missions outline the priorities for mitigation and adaptation to combat climate change in India. The broad policy initiatives of the government's measure are to be supplemented by the actions of the State Governments, Non-Government Organizations (NGOs), initiatives of the private sector and other stakeholders. As a part of this plan, 32 States and Union Territories had already implemented the SAPCCs trying to address the climate change issues in their respective designing method.

The basic principles of the NAPCC are:

- Protection - of the poor and vulnerable sections of society
- Achieving national growth - enhancing ecological sustainability
- Demand side management
- Better technology - considering mitigation or adaptation
- Market mechanism - through sustainable development
- Inclusivity- relating civil society and local government institutions

The action plan outlines a number of steps and climate change-related objectives. It focuses on Eight National Missions:

1 National Solar Mission
2 National Mission for Enhanced Energy Efficiency
3 National Mission on Sustainable Habitat
4 National Water Mission
5 National Mission for Sustaining the Himalayan Ecosystem
6 Green India Mission
7 National Mission for Sustainable Agriculture
8 National Mission on Strategic Knowledge for Climate Change

4.3 Stakeholder workshop

A two-day participatory stakeholder workshop was held in Udaipur which was designed to connect inter-disciplinary teams from various sectors like the government, academicians, practitioners, media and civil society organisations with city-based and technical experts to map children's vulnerabilities and propose resilience strategy that addresses the current and future risks of the city. The aim was to invite stakeholders concerned with the five priority areas – Water, Sanitation and Hygiene (WASH), Health, Nutrition, Education and Child Protection for deliberations.

The workshop was aimed to achieve the following outcomes:

1. Understanding the city – changes and trends, mapping habitation patterns, major assets and its status-change
2. Climate change and impacts, identifying major shocks and stresses because of climate change and induced disasters
3. Causes of such stress/shocks (underlying factors) according to drivers (Physical, Environmental, Social, Economic)
4. Linking drivers with assets and causes to understand what solution (cause) can be thought and which asset will be needed for this
5. Understanding vulnerability of children in the city due to direct/indirect impacts of climate change
6. Identifying resilience actions
7. Short, medium, long-term interventions and related rules/guidelines/programmes that can help
8. Stakeholder engagement and roles

4.4 Field visit and community consultation

The workshop was followed by field visits to identified vulnerable wards in the Udaipur city, low-income settlements and slums to understand the vulnerabilities of children in the face of climate change. The vulnerabilities identified in the stakeholder workshop were further deliberated and vetted by the community groups.

Shared Learning Dialogues (SLD) and Focussed Group Discussions (FGD) were conducted with the communities to source information on their key vulnerabilities and identify resilience actions. SLDs and key informant interviews with government departments were also conducted.

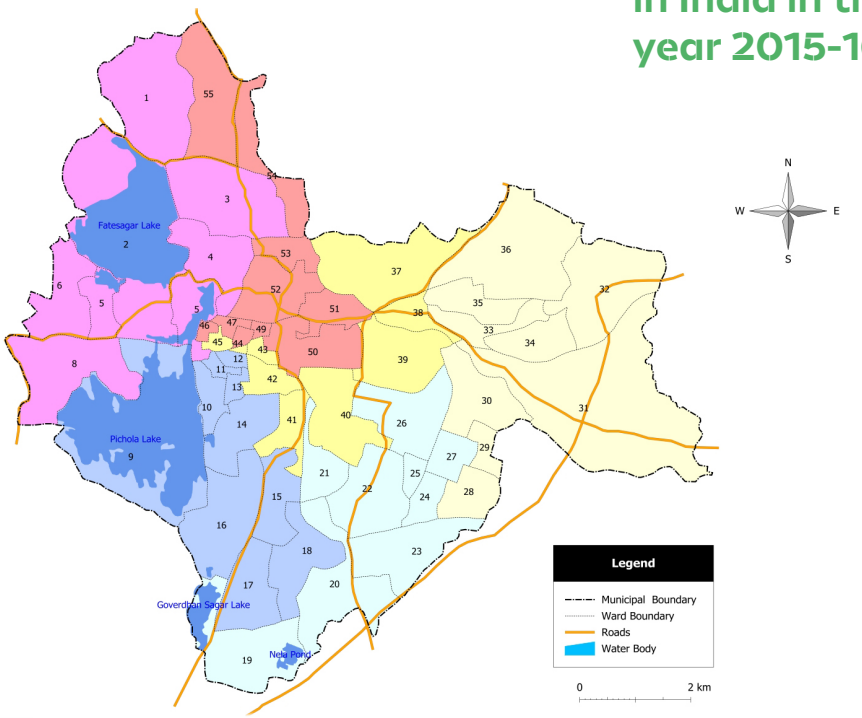
Causal Loop Diagram (CLD) tool was one of the most important tools used in this process, which aided in visualizing how different variables in a system are inter-related. The diagram consists of a set of nodes and edges. Nodes represent the variables and edges are the links that represent a connection or a relation between the two variables. A link marked positive indicates a positive relation and a link marked negative indicates a negative relation. A positive causal link means the two nodes change in the same direction, i.e. if the node in which the link starts decreases, the other node also decreases. Similarly, if the node in which the link starts increasing, the other node increases as well. A negative causal link means that the two nodes change in opposite directions, i.e. if the node in which the link starts increasing, the other node decreases and vice versa. Several linked causes to a particular problem related to children were analysed through this tool. The CLD tool helped in doing a causal analysis of the vulnerabilities of community groups, especially children.

CHAPTER 5

City profile–Udaipur

Udaipur city is the district headquarters of Udaipur district of Rajasthan. It is one of the oldest cities in India founded by Maharaja Udai Singh II of Mewar Kingdom in 1559 (CSP, n.d.). Located at a height of 1,962 feet from the mean sea level and at longitude 73.69°E and latitude

Udaipur was selected in the first top 20 list of Smart Cities in India in the year 2015-16



Map 1: Ward map of Udaipur city

24.57°N, the city is well-connected to major Indian cities like New Delhi, Jaipur, Ahmedabad and Mumbai through roads, railways and air routes.

Also known as the "*City of Lakes*" and "*Venice of the East*" with four beautiful lakes namely Lake Pichola, Lake Fateh Sagar, Lake Udai Sagar and Lake Swaroop Sagar, the city is a famous tourist destination (CDP, 2014). The city spreads over an area of 56.92 sq km (Smart City Profile) (Map 1). During the last few years, the city has expanded to its peripheral areas and as a result of urban expansion, four adjacent towns (census towns-out growth areas) namely Bedla, Baragaon, Bhuwana and Bicchri have been notified as census/urban towns (ibid).

5.1 Topography and geology

The entire Udaipur district is surrounded by mineral-rich Aravalli hills and lakes. On the basis of physiographic and geological characteristics, the district is divided into three regions: tribal, desert and plain regions (CDP, 2014). The city of Udaipur lies separated from the Thar Desert by Aravalli hills (UMC Report, 2016). Located in the centre of a saucer-shaped valley basin, the city has its slope towards the south-east. The city is drained by Ayad river which flows from the north-west towards the south- east (CSP, n.d.). The old city of Udaipur is located on a hillock with its new extensions on a plain terrain. 5 feet thick and 20 feet high massive wall encloses the city. This wall with a circumference of 6 miles and 10 gates were constructed during the period 1615-1734 AD. Predominantly, the hydro-geological formations in and around the city are greywacke and phyllites which have poor groundwater potentiality (CDP, 2014).

5.2 Demographic profile of the city

5.2.1 Population

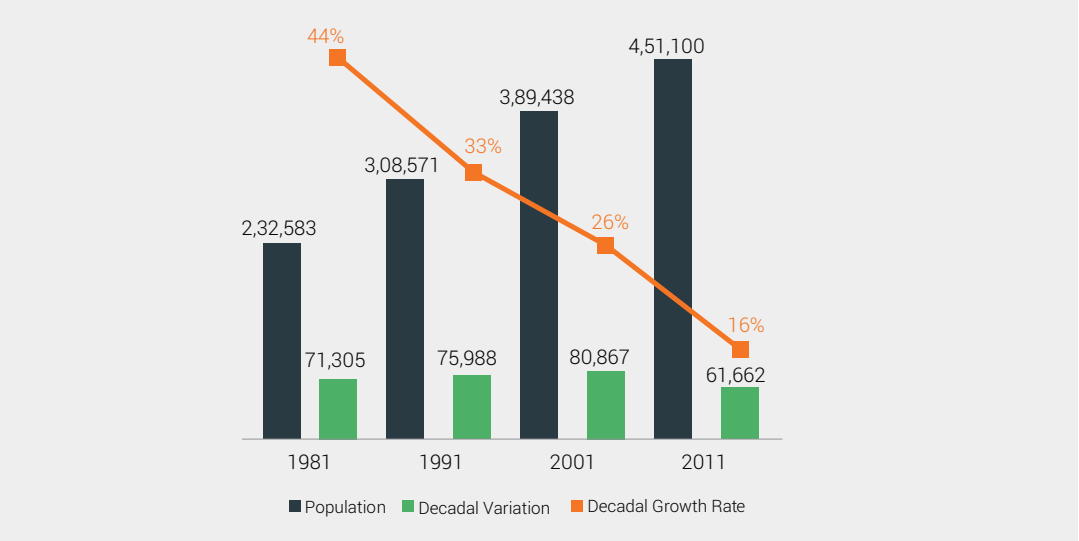


Figure 1: Population growth in Udaipur city

(Source: UMC Annual Report, 2016)

According to Census of India, 2011 the city population of Udaipur is 451,735 out of which male and female population is 234,681 and 217,054, respectively. The population of Udaipur Urban Metropolitan Region is 475,150 of which 246,856 are males and 228,294 are females (CSP, n.d.). The projected population of the city by 2041 is 13.24 lakh. The decadal growth rate from 2001 to 2011 was 15.83 per cent which is a natural growth rate of population. The decrease in growth rate of the city population (Figure 1) can be attributed to the growth of outer peripheral areas and less or stagnated work opportunities for marginal jobs in the core city area (CDP, 2014). Due to the inclusion of census towns- Bedla, Baragaon, Bhuwana and Bicchri in 2011,

the population density has decreased from 10,525 persons per sq km to 7,048 persons per sq km from 2001 to 2011. The density of census towns is 1,515 persons per sq km while the density in core city area is 7,048 persons per sq km.

The number of children up to the age of 14 is 109,600 (Table 2) which is about 24.29 per cent of the total population.

Table 2: Population of children in Udaipur city

Age Group	Population	Percentage of total population
0-6 years	47,932	10.62
7-14 years	61,668	13.67

(Source: Census of India, 2011)

5.2.2 Migration/Floating population

Initially, the population of the city started growing after the partition of India in 1947 when a large number of refugees migrated to Udaipur and settled down there. With its picturesque beauty, the presence of wonderful lakes and grand palaces, the city is one of the most sought-after tourist destinations in the country. The good connectivity of the city due to its presence on the Golden Quadrilateral National Highway (NH-8) makes it all together more accessible. A large number of local and foreign travellers are observed in the city with a footfall of 15 to 18 thousand tourists daily. Out of the total tourist population, around 22-24 per cent is foreign tourists while 76-78 per cent are domestic tourists. Tourist population is expected to increase by 20 per cent by 2041. As per the in-migration statistics of 2001 Census, the city has experienced 34 per cent rural to urban and 49 per cent urban to urban migration of the total migration (CDP, 2014).

5.2.3 Households

According to 2011 Census, there are 94,704 households in the UMC area which were 78,557 in 2001, witnessing a 21 per cent growth over a decade (UMC Report, 2016). The average household size is moderate at 4.76 in 2011. The houses in the old city area are predominantly vernacular in nature while in the new city area there are low rise bungalow type houses. The fringe areas which are also called the urban villages have many medium to high-rise residential projects coming up. The unauthorised houses in the city are in dilapidated conditions with semi-permanent and temporary structures (CDP, 2014). With an average household size of 5 over the next three decades, it is projected that the city will have 1.76 lakh houses by the end of 2041.

5.2.4 Literacy rate

The overall literacy rate according to 2011 Census in the city is 80 per cent while in the census towns it is 76 per cent (CDP, 2014). Literacy rate among men is 84 per cent while among women it is 76 per cent. The overall literacy rate in the city has increased as compared to 2001 Census data with an improvement in male and female literacy rate. An interesting fact to note about the city (UMC area) is that its overall literacy rate in 2011 is higher than the district (61 per cent) and the state (66 per cent) (UMC Report, 2016). The reasons could be attributed to the availability of adequate educational facilities within the city, increase in private educational institutes in and around the city and the efforts of district education department to improve public education facilities in the city (CDP, 2014).

5.2.5 Sex ratio

A significant improvement in the sex ratio has been observed over the decades in the UMC area, from 844 in 1981 to 925 in 2011 (UMC Report, 2016). The sex ratio for children (0-6 years) is 869 which is similar to the sex ratio of the state (CSP, n.d.).

5.2.6 Economic profile of the city

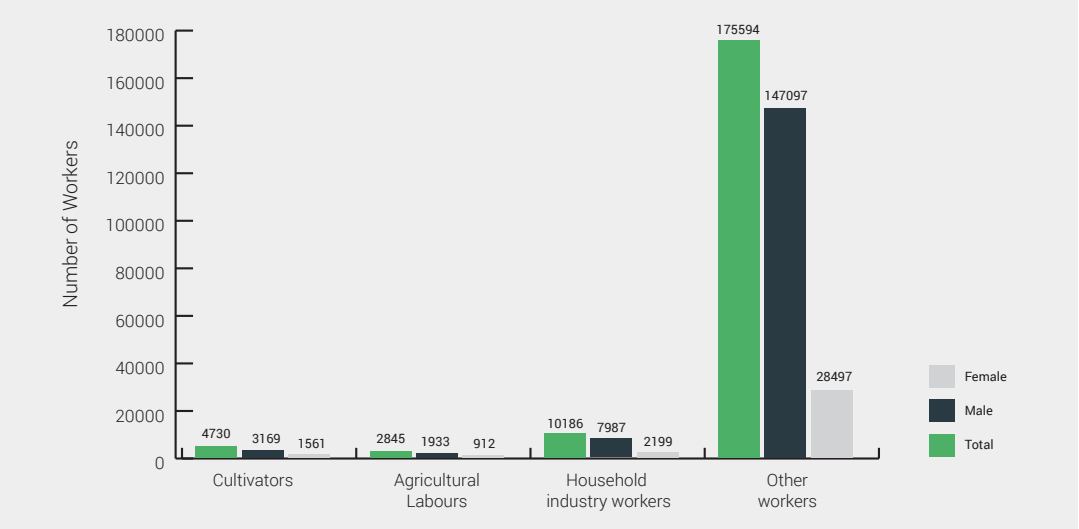


Figure 2: Main workers participation of Udaipur city

(Source: 'City Sanitation Plan-Draft Report-Udaipur City')

The city has a diverse economic base with tourism, commerce and industry, administration and trade, agriculture and education as major economic sectors. Tourism has been the centre of attraction for the last few decades and the catalyst of Udaipur's economic growth, growing at over 15 to 20 per cent. There are 14, 678 commercial establishments in the city which are mostly associated with metals, automobiles, stone grinding and auto repair workshops (UMC Report, 2016).

According to the sectoral distribution of working-class population, 7.60 per cent are involved in the primary sector, 28.89 per cent in the secondary sector and a majority of 63.51 per cent are involved in the tertiary sector (Smart City Profile of Udaipur). The workforce participation rate (WFPR) was 34 in 2011 not showing significant improvement from previous Census at 32.12. Male workforce participation is 81 per cent of the total WFPR while female workforce participation is only 19 per cent (CDP, 2014). Due to the presence of plain area in northeast part of Udaipur, secondary and tertiary activities are increasing in this direction. Areas near water bodies and highways of Udaipur are the centre of major developmental activities. The city is also a hub of educational institutes with the presence of 3 universities, 6 colleges, more than 160 high schools (UMC Report, 2016) and many other institutions like polytechnic and railway research institute etc.

5.2.7 Slums

The slum population in the city is 11 per cent of the total population in 39 slum pockets inhabiting 9,529 households and 47,636 people. Average household size in slums is five persons per family. Mostly, the slum pockets are located along the lakes, water bodies and in the old city area. Out of the total slum population, around 14 per cent is below poverty line population. All slums are notified slums in the city with land ownership with the Urban Local Body (ULB). The slum pockets are not connected to drainage and sewerage network. A large

number of slum dwellers of the city i.e. 1,702 households (CDP, 2014) perform open defecation in surrounding vacant and agricultural lands. The slum dwellers living near the railway line use the tracks for defecation (CSP, n.d.). Only 55 per cent households have access to drinking water and toilet facilities. Duration of water supply is less than one hour and sometimes there is no supply at all.

5.3 Urban local governance in Udaipur city

The 'Mewar Dynasty' constituted the Municipality of Udaipur in 1922. Presently, the city is governed by UMC which has been upgraded from a Municipal Council in the year 2013. It is the only Municipal Corporation in the district of Udaipur with jurisdiction over 64 sq km after cities' expansion. There are 55 election and revenue wards in the city (Map 1).

Institutions	Development of Master Plan	Land Development	Water Supply		Sewerage		City Roads	SWM	Housing
			Development	O&M	Development	O&M			
Town & Country Planning Organisation (TCPO)	■								
Municipal Corporation						■	■	■	
Other ULBs (Municipal Councils, Municipalities, etc.)		■				■		■	■
Urban Development Authorities (UDA)		■							
Urban Improvement Trusts		■							
Public Health & Engineering Department (PHED)			■	■	■				
Public Works Department (PWD)							■		
Rajasthan Housing Board (RHB)			■	■	■	■		■	■

Figure 3: Institutional responsibility matrix-Udaipur

(Source: 'City Sanitation Plan-Draft Report-Udaipur City')

UMC plays a limited role in the provisioning of urban basic services with lower financial responsibilities (Figure 3). It takes care of solid waste management (SWM) and roads and sewerage in the city. Public Health and Engineering Department (PHED) provides water to the city. Development of new projects for sewerage and roads is taken by the Urban Improvement Trust (UIT) (CDP, 2014).

5.4 Udaipur Smart City

The city of Udaipur was selected in the first top 20 list of Smart Cities in India in the year 2015-16. The Ministry of Urban Development (MoUD) has approved a total investment plan of Rs. 1,221 cr for the city. As tourism is the key economic driver for the city, this sector has been picked up as the key focus of Smart City Development. The strategic focus of the city is to increase the tourist influx by 15-20 per cent. Area Based Development (ABD) will take place in the walled city which is also the core of tourism. Infrastructural developments like rehabilitation of existing old and damaged sewerage system by pipe bursting/CIPP technology with laying of new sewerage line by trenchless technology, 24X7 water supply, underground power cabling, cobbled pathway at some important heritage walk, conservation of heritage buildings, relaying of road and the implementation of smart compounds like parking, vehicle tracking system, Wi-Fi spots by laying Optical Fibre Cable etc will take place in ABD area. Pan city solutions will be applied to areas outside ABD. Improving the existing sewerage system will stop the contamination of lakes in the city. The Smart City Proposal aims to achieve maximum developmental impact through the transformation of the walled city and its adjoining lakes (Smart City Proposal- Udaipur).

CHAPTER 6

Climate change impacts and urban poor children

To understand the different vulnerabilities among urban poor children in Udaipur, in the context of climate change and disasters, the vulnerability assessment looked at five key domains of children's development which guide the overall growth and development in children. These domains of children's development are – Health, Education, WASH, Nutrition and Child Protection. These domains are the primary lenses through which vulnerabilities of urban poor children were assessed in the city.

"There may be no greater, growing threat facing the world's children – and their children – than climate change"

– UNICEF, 2015

6.1 Health

Children's health is primarily determined by the socio-economic and physical conditions of the environment in which they live and are nurtured. Climate change alters the frequency, timing, intensity and duration of weather events. In such situations, the vulnerabilities of the children residing in the fragile fringes of the city and slums with poor basic facilities which get aggravated in times of

extreme weather events further increases. Climate change affects the growth and survival of disease-causing organisms related to water- and food-borne illnesses. The incidence of water- and food-borne illnesses, such as gastroenteritis and infectious diarrhoea, is known to increase when outdoor temperature increases, or immediately following storms or floods. High disease load in slums eventually manifests as under nutrition and stunting among young children. Extreme weather can result in the breakdown of sanitation and sewer systems, or inadequate means to cook food, increasing the likelihood of water- and food-borne illness. Children are especially susceptible to water- and food-borne illness due to their developing immune systems. Health is closely inter-linked with livelihoods and income, nutrition and water and sanitation facilities. During this assessment, these aspects were closely studied in order to understand the issues of health among children living in different situations.

6.2 Education

Proper schooling and education are closely linked with the elusive triangle of its access, equity and quality for these urban poor children. In the wake of changing weather patterns, this is influenced by declining livelihood opportunities, migration, inaccessibility to schools and health care facilities etc. Climate-induced disasters hit the poor communities who are then forced to discontinue their children's schooling. Displacement due to rural-urban migration which leads to the problem of identity also adversely impacts education and other child rights.

6.3 Child Protection

Children living in slums, city fringes and low-income settlements which are devoid of basic amenities grow up in a volatile environment where safety is always in question. During extreme temperatures and rainfall, physical safety becomes a problem for the children. These slum children and also those living on the streets face extreme vulnerability and deprivation of basic entitlements. Lack of proper upbringing due to various reasons makes them vulnerable to drug abuse, sexual abuse, substance abuse, trafficking and gambling etc. Climate change and disasters cause large-scale dislocation of poor people from rural to urban areas or even within the urban areas. Eviction drives in the informal settlements and slums in the cities hamper the physical safety and protection of children, leaving them in a traumatic situation.

6.4 Nutrition

Though urban children are considered to have better nutritional status, several researches have evidenced that urban malnutrition is on a rise. Children, in their growth period, are vulnerable and need proper food and nutrition for their overall development. Repeated incidences of acute diarrheal disease during childhood due to lack of appropriate sanitation and safe drinking water and hygiene in slums is one of the drivers of undernutrition, which is closely linked to exposure of slums to waterlogging and floods. Nutritional inadequacies result in the hampering of the development of their body. If this nutritional inadequacy persists for a longer period of time, it results in their improper growth manifested in the form of low weight, stunted height, low IQ, etc. Child malnutrition is the single biggest contributor to under-five mortality due to greater susceptibility to infections and slow recovery from illness. Droughts that lead to food shortages are likely to lead to malnutrition, affecting the health and development of urban poor children.

6.5 Water, Sanitation and Hygiene (WASH)

Unsafe water, poor sanitation and unhygienic conditions claim many lives each year. Poor urban areas where insufficient water supply and sanitation coverage combine with overcrowded

conditions tend to maximize the possibility of faecal contamination. Open defecation in densely populated urban settlements is particularly alarming for public health. To top it all, the effects of climate change are often experienced through the water. Climate-induced disasters severely affect the infrastructure and services related to drinking water, sanitation and hygiene. Floods inundate tube-wells, ponds and water bodies and contaminate the natural sources of fresh water thereby forcing affected communities to use unsafe water. Toilets are generally fragile and mostly unsuitable to withstand high flood or cyclone. It leaves people with no other option but to go for open defecation. Such crisis in safe water supply and sanitation service severely disrupts hygiene practices. Because of water contamination, public health situation often deteriorates spreading water-borne diseases like diarrhoea, cholera, typhoid and hepatitis.

CHAPTER 7

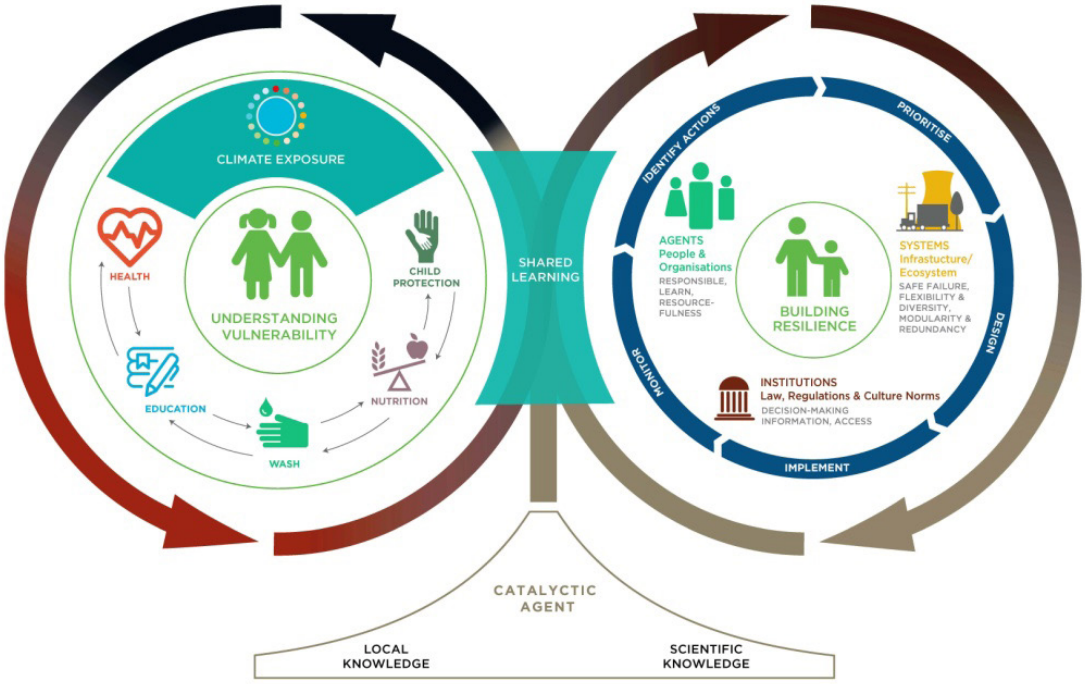
Child-centered urban climate resilience framework

The Child-centered urban climate resilience framework (Figure 4), adapted from the internationally acclaimed CRF developed by ISET-International, is an integrated approach for understanding vulnerabilities of urban poor children, one on part, due to climate change impacts around their five key development parameters – Health, Education, Child Protection, Nutrition and WASH. On the other hand, it focuses on the critical roles of Systems, Agents and Institutions across these five development parameters and the manner in which, with their own resilient characteristics, they can contribute in building UCCR for children. It also incorporates the concept of shared learning as part of an iterative process in which the analysis feeds into planning, planning into actions, actions into learning, learning into further cycles of analysis and so on. This iterative, shared action-learning cycle fosters building and maintaining resilience over time, in the face of rapidly evolving contexts and high levels of uncertainty.

The climate change vulnerabilities of urban poor children were assessed around their five key development parameters – Health, Education, Child Protection, Nutrition and WASH

To explain, the left circle helps in assessing vulnerabilities due to climate change exposure on five key development parameters – Health, Education, Child Protection, WASH and Nutrition. Also, the causes of vulnerabilities across these five thematic areas are inter-linked and inter-dependent on each other. The right circle helps in understanding the key resilience mechanisms at three levels – Agents, Systems and Institutions, across the five development parameters of children. The framework also suggests the key characteristics of Agents (Responsible, Ability to Learn and Resourcefulness), Systems (Flexibility, Diversity, Modularity, Redundancy and Safe Failure) and Institutions (Decision Making and Information Access). It further guides that for resilience planning, it is important to *identify actions* across key thematic sectors, *prioritize actions*, *design* resilience options/solutions, *implement* them and *monitor* them around a set of key indicators.

This framework guides efforts to build urban resilience that support children, youth, girls and boys. It integrates child and human rights into resilient urban development, enabling children to become agents of resilience.



Adapted from Climate Resilience Framework, ISET International

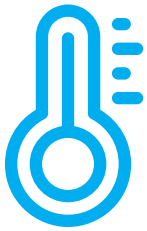
Figure 4: Child-centered urban climate resilience framework

CHAPTER 8

Climate and climate variability in Udaipur city

The city of Udaipur is famous for its pleasant climatic condition in Rajasthan. But the rapid expansion of the city, industrialisation in the peripheries and unceasing demand of houses and other urban basic services of the urban population have imposed serious impacts on the natural heritage of the city, socio-economic conditions and on the critical infrastructure located in and around the city. In the last few decades, impacts of climate change are acting as externalities and influencing the existence of natural heritage and scenic beauty of the city.

City's air quality is degrading due to increased vehicular movements and traffic, cutting of trees, deforestation along hill slopes, burning of wood and charcoal in low-income areas. Air pollution in the city has also the potential to alter rainfall patterns. Usually, the Respirable Suspended Particulate Matter is higher than 100 µg/m^3. Due to river basins, Udaipur is prone to flooding. On the basis of historical data, droughts occur once in every 6 years



Number of days with temperature above 40° C is increasing

in Udaipur. The five major disasters identified for Udaipur district are drought (moderate), flood (moderate), wind (low), industrial accident (low) and earthquake (low) (CDP, 2014).

8.1 Observed climate

The city has a tropical climate. It experiences three seasons: summer, monsoon and winter. The analysis of historical climate data of IMD of the last 115 years depicts clear indication of season-wise variability in temperature, both maximum and minimum. Moreover, trends in rainfall pattern and number of extreme events of hot days and heavy rainfall have changed significantly.

Being located in the desert land of Rajasthan, the climate and weather of Udaipur is usually hot, but the alignment of Aravalli Hill has impacted the climatic conditions of the city. The analysis of historical data (115 years) of climatic components like temperature and rainfall indicates that the summer season in the city runs from mid-March to June and touches temperature ranging from 23° to 46° C in the months of March to June. The maximum temperature ranges from 35° to 42° C on most of the days during the summer season. The highest maximum temperature during April to June months has yet been recorded as 44.4°, 46.4° C and 46.2° C respectively. Heatwave also prevails for a few days in the summer season, when day's temperature rise to 4° to 6° C above normal. In winter, the minimum temperature remains around 5° to 10° C or so when chilly wind (northerly) blow from the Himalayan Region. Mist also occurs at a few occasions in the morning hours after the incursion of moisture from the Arabian Sea. The minimum temperature as low as -1.2° C, was recorded on 1 January 1991.

The analysis of maximum temperature data of the city indicates that the upward surge in temperature starts from April and it reaches a peak in the month of May with the average value of 39.8° C. The downward trend in minimum temperature commences in September and continues up to January. January is the coldest month with an average minimum temperature of 7° C. Annual average maximum and minimum temperatures are 31.8° C and 17.2° C, respectively.

In comparison to other parts of Rajasthan, the city of Udaipur is humid. The annual mean rainfall of this place is 654.7 mm with some variations. Rainfall increases from the month of June (normal rainfall 65 mm) when thundery activities start and July (normal rainfall 199 mm) and August (normal rainfall 198 mm) are the rainiest months. Monsoon generally sets around 20th June and last up to the middle of September. Rainfall decreases sharply in October and November. These are the transit months. The analysis of daily rainfall statistics of last 115 years reveals that in about 74 per cent cases the daily rainfall occurred was less than 5 mm, in 13 per cent cases the range was between 5 to 10 mm and in 6 per cent cases it was between 15 to 20 mm. The daily rainfall exceeding 50 mm is rare. However, there are cases when a range of 50 to 150 mm was also observed. The normal annual rainy days in the Udaipur district are about 96 days. The lowest (58) rainy days were observed during the year 2000 and the highest (145) days during the year 1961.

The analysis of monthly rainfall data at the interval of 30 years indicated a skewed behaviour towards August. Figure 5 shows the average monthly pattern of rainfall during different time period. It shows that highest monthly rainfall (34 per cent of annual rainfall) is realized in July. But temporal analysis has clearly indicated that average rainfall of August is increasing.

In the last few decades, especially after the 1980s, the frequency of extreme rainfall events has significantly manifested and has spatial variations/ scales over different stations of Udaipur. The highest (2068 mm) and the lowest (140 mm) annual rainfall were realized in Kotra and Vallabhnagar *Tehsils*. The observation and analysis of historic extreme events indicated that

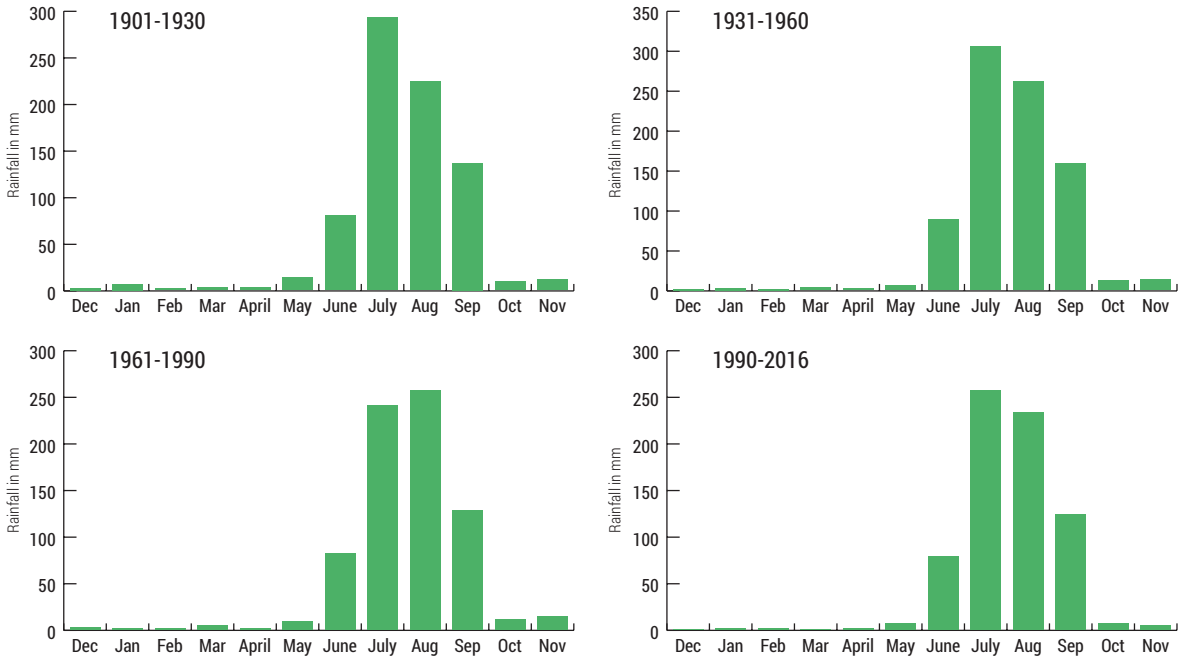


Figure 5: Average monthly pattern of rainfall during different time period

in a 24 hour time, the highest rainfall of 145 mm was recorded on 8 September 1994 over Udaipur ; 177 mm on 30 June 1983 over Girwa ; 205 mm on 2 August 2006 over Gogunda; 190 mm on 11 July 2012 over Vallabhnagar; 252 mm on 1 September 1973 over Kotra; 228 mm on 30 June 1983 over Mavli ; 282 mm on 1 September 1973 over Jhadol; 300 mm on 8 September 1973 over Salumber; 182 mm on 16 August 2006 over Kherwara; 159 mm on 8 September 1973 over Sarara and 1089 mm on 16 August 2006 over Rishabdeo.

8.2 Seasonal variation and impression of climate change

8.2.1 Temperature variation

As it is mentioned above that city is experiencing significant seasonal variability in temperature and rainfall pattern. For its clear understanding, the impression of climate change impacts and variability in maximum and minimum temperature has been assessed on the basis of daily data of last 115 years from the baseline of 1901 to 1930 average data. Figure 6 and 7 show the maximum and minimum temperature anomalies from the baseline years (1901 to 1930). The inferences from the data analysis and interaction with community revealed the following points:

1. No significant trend has been noticed in mean maximum temperature, both spatially and temporally in monsoon season.
2. The highest increase in seasonal mean maximum temperature has occurred in post-monsoon season
3. Increasing trend in maximum temperature in summer season has been observed
4. The number of heat strokes among the school children or children working in open has increased due to increasing temperature in summer season
5. Significant increasing trends in maximum temperature especially in December and February have been observed.

6. The increasing trends of maximum temperature during the winter season is a serious indication of climate change and health-related risks in the city
7. The number of days above 40° C is increasing

Winter season is becoming warmer as per community's perception. Daily data analysis of the last 115 years indicated that minimum temperature is increasing in all the seasons. As per community's perception, the increasing trend in minimum temperature during winter is more prominent and it has serious impacts on the socio-economic aspects of life of the people whose livelihood is dependent on the tourism industry.

Figure 6: Maximum temperature anomalies from the baseline 1901 to 1930

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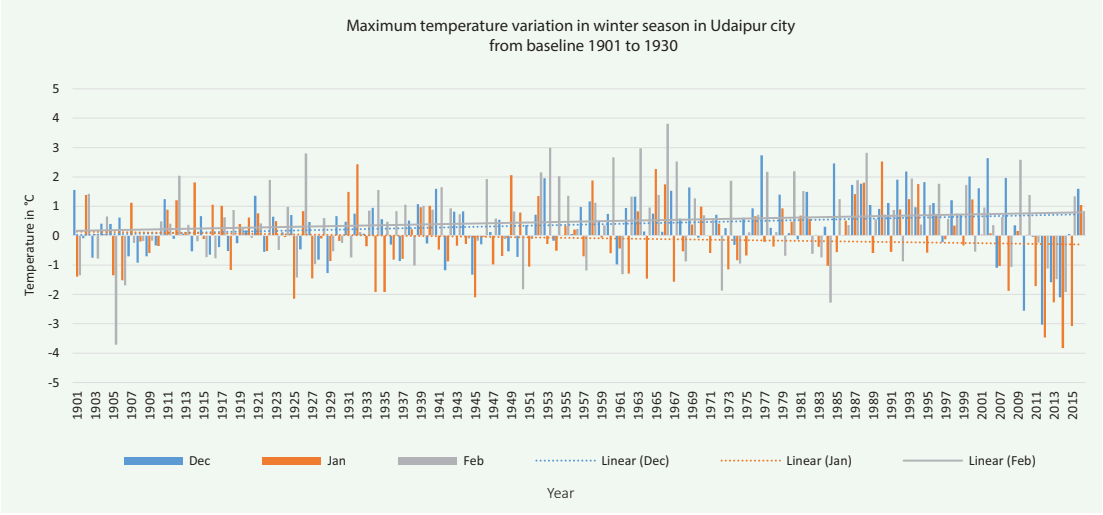

Figure 6: Maximum temperature anomalies from the baseline 1901 to 1930

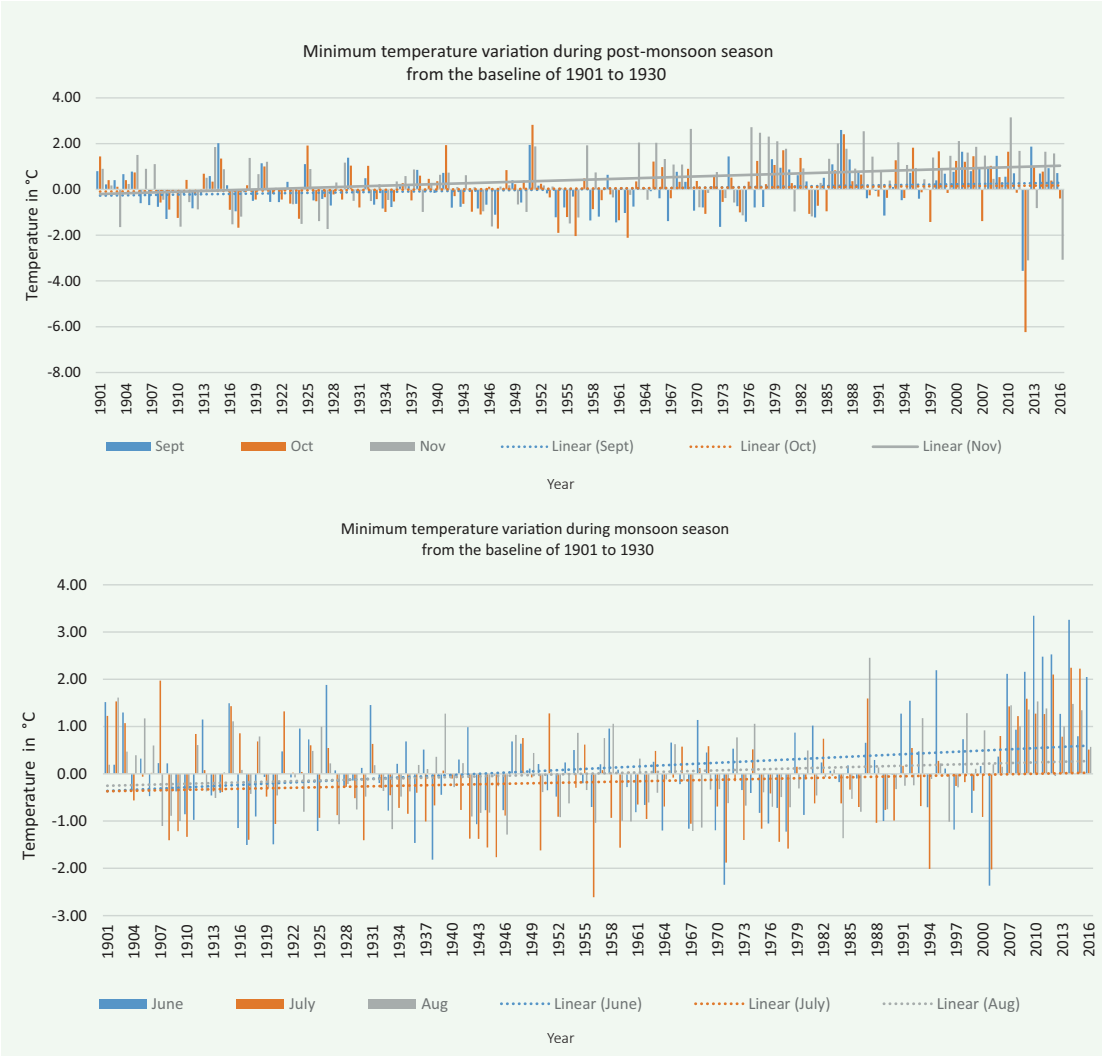

Figure 7: Minimum temperature anomalies from the baseline 1901 to 1930

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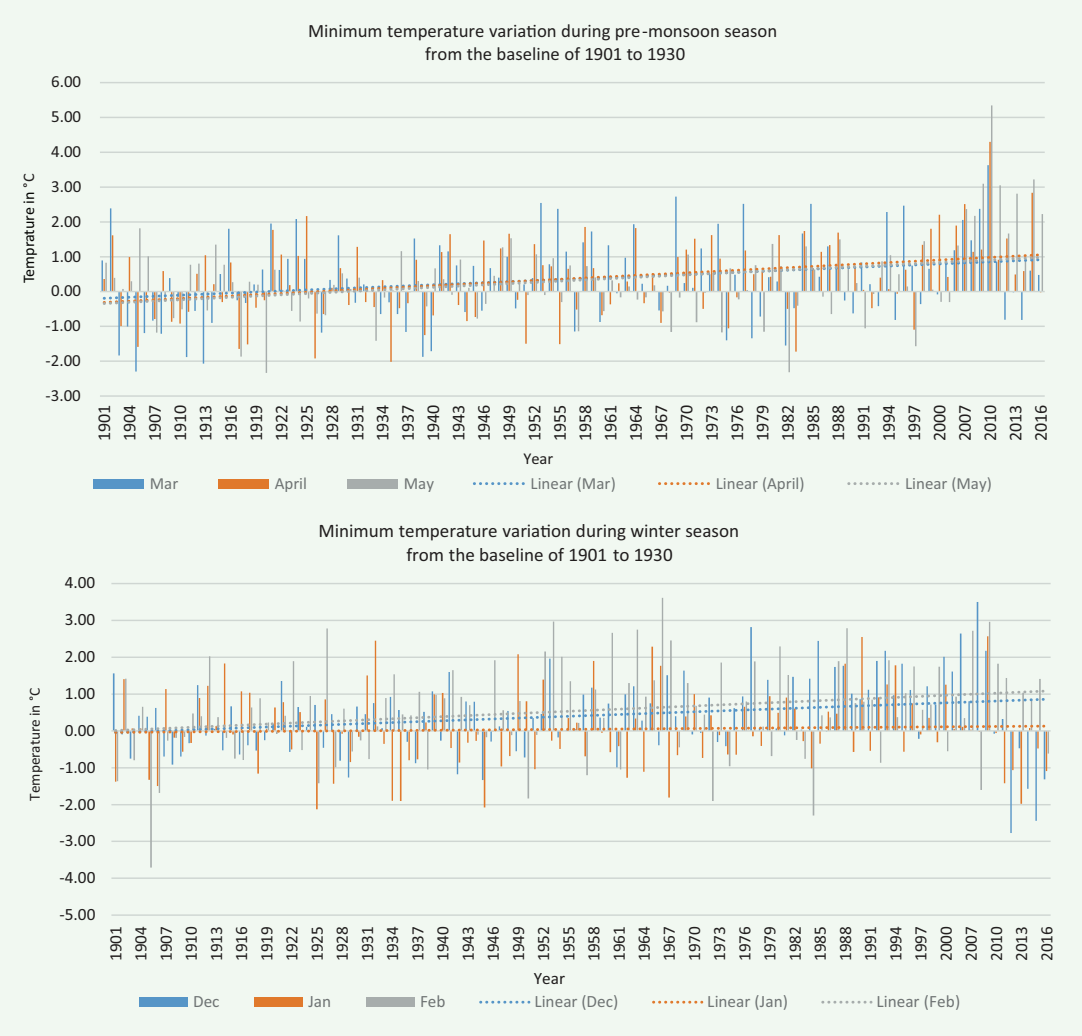


Figure 7: Minimum temperature anomalies from the baseline 1901 to 1930

8.2.2 Seasonal rainfall variability

Overall, the rainfall amount is gradually declining in the city. Figure 8 clearly indicates the declining trend over the last 115 years (1901 to 2015). To assess the impacts of climate change, seasonal variation in rainfall was assessed for: winter (December to February), pre-monsoon (March to May), monsoon (June to August) and post-monsoon (September to November).

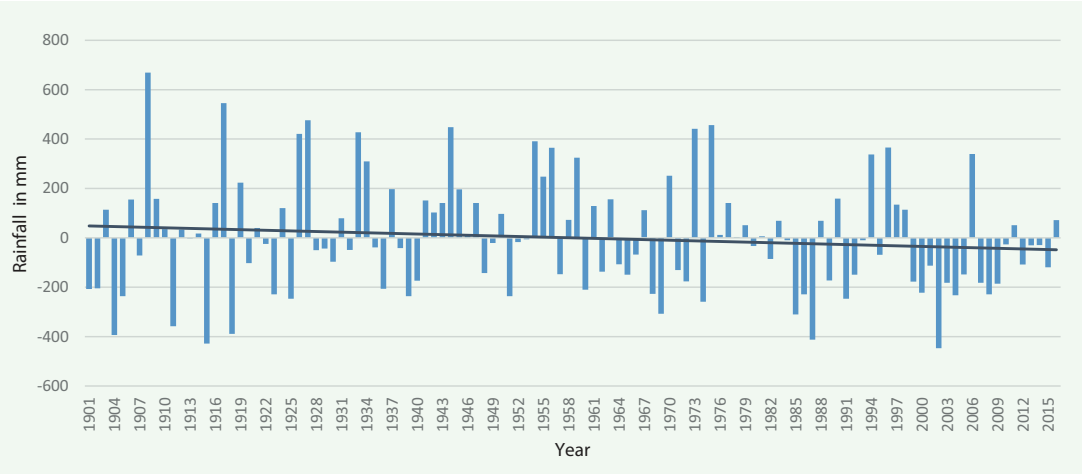


Figure 8: Rainfall variation during 1901 to 2015

Total rainfall during the winter season is lowest among all seasons. The rainfall is rather more in summer and post-monsoon season than winter. Figure 9 shows the seasonal deviation of rainfall from the baseline years (1901 to 1930). It clearly indicates that rainfall in winter, monsoon and post-monsoon season has declined. The rate of declination during winter and pre-monsoon season is very significant while in post-monsoon it is insignificant.

Figure 9: Seasonal deviation of rainfall from the baseline 1901 to 1930

8.3 Projected changes in rainfall over Udaipur

Regional Climate Modelling (RCM) projections for Udaipur using the A1B scenario conducted for near-term of 2021-2050 projects an increase in rainfall by 2050 as follows:

- Rainfall is projected to increase under the A1B scenario by the year 2050
- Mean annual rainfall is projected to increase by 6-10 per cent
- Mean monsoon rainfall is projected to increase by 40-60 mm by 2050
- Most of the increase will occur in the monsoon period
- There is a slight decline in winter and post-monsoon season rainfall towards 2050 under the A1B scenario
- Extreme rainfall is expected to increase in frequency and intensity. Projections for 2050 show an increase of 20 mm for maximum 1-day rainfall and 30 mm for maximum 5-day rainfall.

8.4 Projected changes in temperature over Udaipur

RCM projections for Udaipur using the A1B scenario were conducted for near-term of 2021-2050. It indicates an all-round warming over the Indian sub-continent associated with increasing greenhouse gas concentration. The RCM simulation of A1B scenario is given below:

- Annual maximum temperature is projected to increase by 1.75° to 1.85° C by 2050
- Annual minimum temperature is projected to increase by 2.1° to 2.2° C by 2050
- Annual mean maximum temperature in the post-monsoon season is likely to rise by 2.0° C by 2050. Whereas in the winter season it is projected to be changed by 2.25° C by 2050
- Annual mean minimum temperature is projected to be changed by 2.8° C by 2050 during post-monsoon season
- Annual mean minimum temperature is likely to rise by 1.5° to 2.45° C by 2050 during monsoon and summer season respectively
- Hot days and warm night might increase
- The probability of occurrence of mild to severe drought is high

A1 Emission Scenario: The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end-use technologies.

(Source: https://www.ipcc.ch/ipccreports/tar/wg1/029.htm)

CHAPTER 9

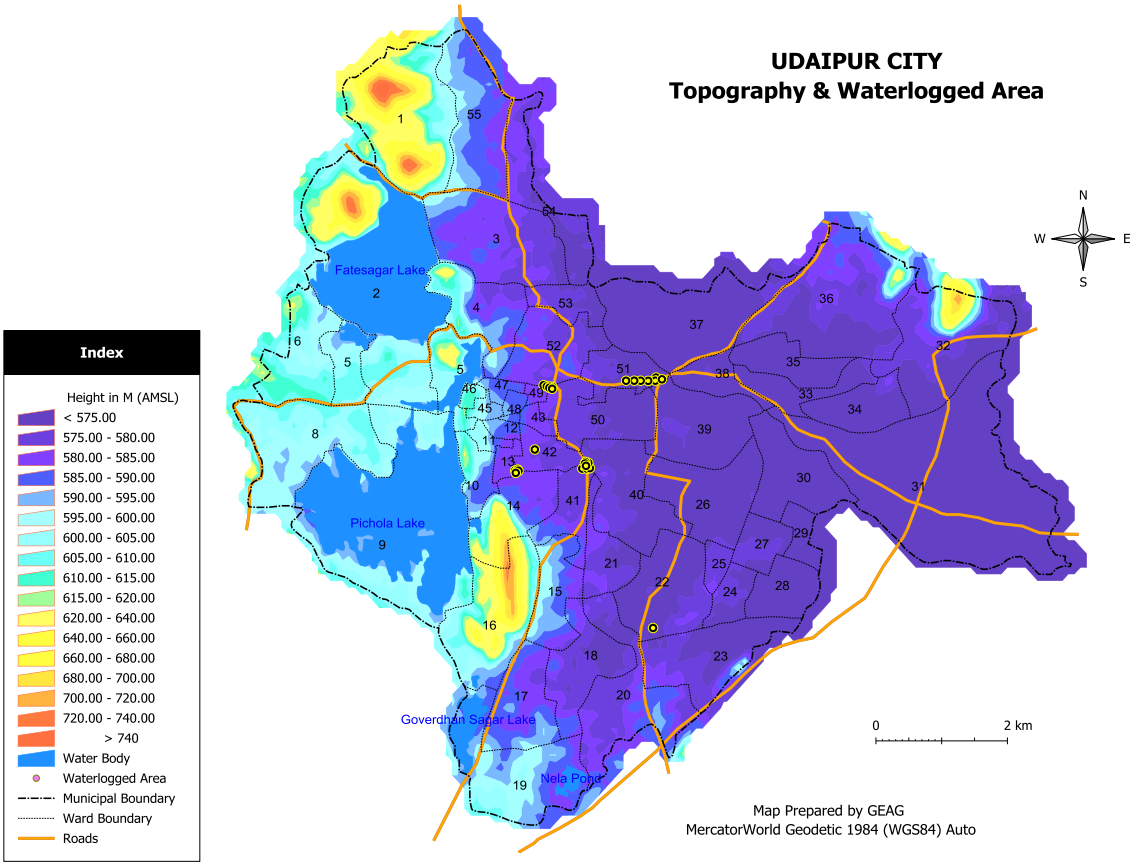
Vulnerability analysis of Udaipur city

9.1 Vulnerability risk frame of Udaipur city

Udaipur is blessed with a large number of water bodies, providing a congenial climate and good availability of water in the arid state of Rajasthan. The surrounding hilly ecosystem with dense vegetation provided the city with a micro-climate of moderate temperature regime and adequate rainfall. The natural and traditional waterbodies and effective recharge systems have been the source for continued supply of water and rainwater harvesting, with River Ayad, flowing right across the city providing recharge needs. The combination of a large number of lakes and reservoirs, traversing river and the adjoining hilly system created a situation which maintained an urban ecosystem able to absorb small changes and disturbances. However, the deterioration of this natural ecosystem-based urban system has made the city vulnerable to external shocks and emerging climate change variations have posed new challenges.

Most of the lakes in the city are in danger of incorrigible degeneration due to degradation of catchment areas and untreated sewerage dumping

The mal-development and inadequate basic services in the city and change in population and inhabitation patterns have contributed to increasing the intensity of such challenges. The mounted infrastructure and services required for increasing needs of the population particularly related to factors like sewerage, sanitation and drainage system have caused problems like groundwater depletion, contamination of surface and groundwater and air pollution (Box 3).



Map 2: Topography and waterlogged areas of Udaipur city

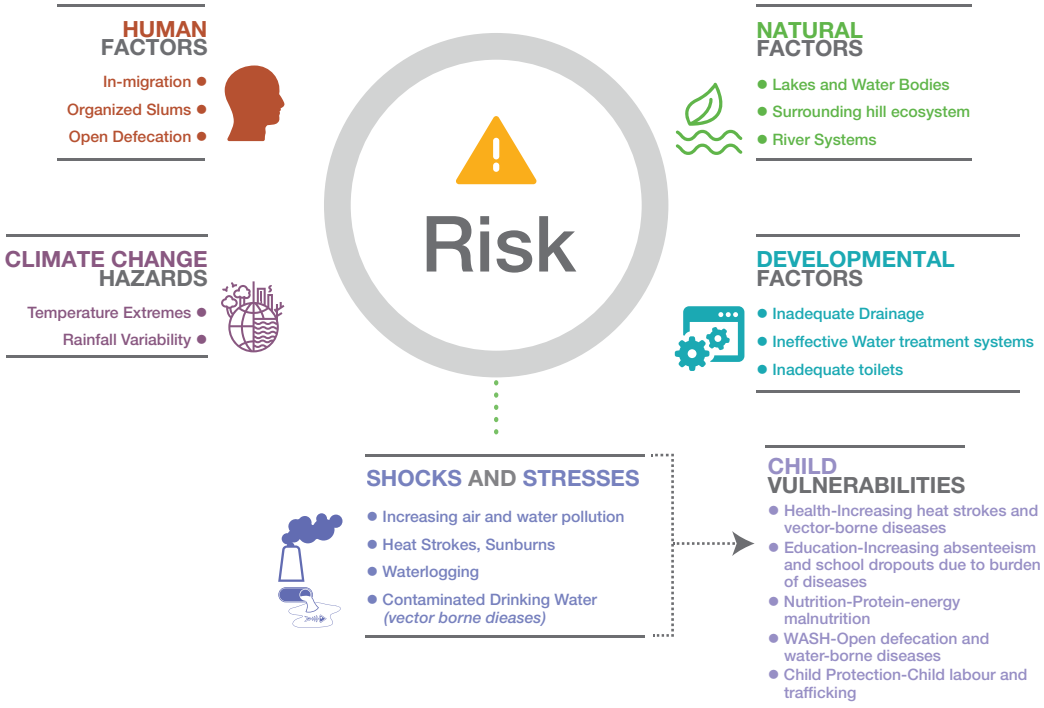


Figure 10: Climate risk frame of Udaipur city

The surrounding hills and its dense vegetation located in the peri-urban areas of Udaipur city are continuously being degraded and this is adversely impacting the urban ecosystem of the city. Incidences of waterlogging are also reported to be increasing in the city (Map 2). Lack of sewerage system and water treatment facilities have resulted in the availability of contaminated drinking water to the city people and hence increasing incidences of water-borne diseases particularly in children have been observed. Inadequate toilets and open defecation are further aggravating the risks of vector and water-borne diseases.

The resulting situation due to the close inter-connectedness of such natural, developmental and human factors of urban system enhance the vulnerability of city in the events of climate variability (current and projected future) leading to enhanced shocks and stresses of urban people and hence the overall risk of the city (Figure 10). The most vulnerable population groups in such situations are women, children, slum-dwellers and low economic profile population who have limited access to services and capacities to deal with such shocks and stresses. Temperature extremes and rainfall variability have been causing cold wave exposures, heat stroke, sunburn, increased incidences of water and vector-borne diseases, waterlogging and adversely impacting the Health, Education, Nutrition, WASH and Protection related aspects of children.

Box 3: Highlights of key city level challenges

Solid Waste Management: The city generates 231 metric tonnes of solid waste per day which includes wastes from households, commercial establishments, institutions and waste from street sweeping. Only 120 metric tonnes are collected and disposed of daily by UMC (CSP, n.d.). Door to door collection is not in practice. There is no source segregation of waste (UMC Report, 2016). The key deficiencies in the SWM system in the city are lack of sanitation workers, lack of collection efficiency, improper choice of technology, improper site of solid waste dumping (absence of scientific disposal), lack of trained manpower and poor public participation and cooperation. The city's problem of managing the solid waste is increasing day by day with the growth of population and a huge influx of tourists (CSP, n.d.).

Insufficient Heritage Management: The city is losing its historic identity and culture due to lack of civic awareness on heritage and conservation. Contemporary architecture is replacing the historic Mewar heritage due to commercialization. Due to high maintenance/repair cost of the traditional houses in the walled city, the risk of demolition by the owners themselves is increasing (CSP, n.d.).

Lake Pollution: The City of Lakes is dependent on its lake system which is the life source of the city in terms of surface water resources, tourism and the ecosystem at large. Most of the lakes in the city are in danger of incorrigible degeneration (RSAPCC, 2010). Changing land-use and degradation of the catchment areas has disturbed the whole balance of the reservoir ecosystem. At 45 drain spots, untreated sewerage is being released into the lakes. Approximately, 500 tonnes of solid waste is getting dumped into the lakes annually. The lakes are getting dried due to the inconsistency of rainfall and degradation of the catchment area. The depth of the lakes has reduced to a quarter of which it used to be 40 years ago due to heavy siltation after deforestation in the catchment area.

Water Supply: With a length of 400 km, the existing water distribution system in the city covers 80 per cent of the city area. The total water demand in the city is 97.13 MLD and the current supply is only 66.76 MLD creating a supply and demand gap of 30.37 MLD. The water is supplied alternatively for the duration of 45 to 90 minutes in different areas. The key issue regarding the present water supply in the city are old distribution pipelines which are highly scaled and, large distribution losses. The net per capita water supply is 119 LPCD which is below the standard of 135 LPCD. In summers, the situation becomes worse when per capita water availability drops down to 90 LPCD. The existing water treatment capacity is also inadequate at 82.97 MLD (CSP, n.d.).

Open Defecation: Under UMC area there are 88, 857 households out of which 93.82 per cent have toilet facilities at premises and the rest 6.18 per cent are either going for open defecation or going for public toilets like Sulabh Complex. Pit latrine system is there in most of the individual toilets without outlet baffles. Blackwater from rest of the houses having septic tanks flows directly to the drains and merges with the river system. The unpaid public toilets and urinals in the city are in very bad conditions with lack of cleaning, water supply and electricity (CSP, n.d).

Sewerage: The city of Udaipur lacks an integrated underground sewerage system. Only 440 ha of the city areas are sewer covered which is less than 10 per cent of the total city area. This area includes the walled city, Ambamata Colony, Mallatalai Colony, Ekalavya Colony and the colonies which are situated around the lakes. Rest of the households have leach pits, septic tanks or pit latrines. Only about 3,600 old sewer connections exist in the entire city as against 88,857 households as per Census 2011. The effluents from septic tanks of households are directly disposed to open channel drains or open grounds near the houses. Untreated sewerage from the trunk line in the old city area is directly falling in River Ahar in Manw Khera village (CSP, n.d.).

Drainage and Storm Water Management: Generally, the undulating topography and the presence of a large number of water bodies in the city prevent drainage issues. However, at few places, prolonged drainage congestion occurs due to irregular and unlined drains, choked and malfunctioning vents of the cross drainage works. The major drains invariably carry sewage and sullage flow in the absence of branch and trunk sewers thereby increasing the quantity of flow in the drains. Major flood-prone areas in the city are: Transport Nagar, Futa Talao, Gariawas, Gayatrinagar, Roadways bus stand, Delhi Gate, Sobhagpura Abhinandan Complex, Mahaveer Nagar, Pancharatna Complex and down-stream of Maha Satya. The key issue leading flooding in these areas are the haphazard expansion of settlements and encroachment of drains, uncontrolled disposal of solid waste into drains, absence of integrated drainage network in new layouts, narrow drains and poor motivation and public awareness (CSP, n.d.).

9.2 Vulnerable hotspots in the City

Being a fort city, there is a limited scope of development in the central part. Consequently, around the fort area, especially in east, north and southern parts, the city boundary has expanded. These expanded areas are still lagging behind in terms of basic facilities. Though, the municipal corporation is proactively developing the infrastructure like drainage, water supply and sanitation system but still the wards in outskirts have poor drainage and water supply system. Before grounding to do the vulnerability assessment and community consultation to understand the vulnerabilities of children among different socio-economic groups, available spatial secondary data (ward-wise) was analysed. It particularly involved the data about the source of drinking water, its accessibility, access to toilet facilities and drainage network system. The compiled data was then analysed to identify the hotspots (vulnerable wards) of the city.

This process of secondary data analysis was very helpful in selecting the wards for community consultation. Three colours (green, yellow and red) were used to denote **good (green)**, **moderate (yellow) and poor (red)** status of the services that the ward possesses (Figure 11).

Area Name	Main Source of Drinking Water			Location of drinking water source			Number of household s not having latrine facility	Open	Waste water outlet connected to		
	Tapwater from treated source	Tapwater from un-treated source	Handpump	Within premises	Near premises	Away			Closed drainage	Open drainage	No drainage
Ward No.1	77.2	2.5	15.1	72.8	15.1	12.1	24.1	21.9	34.8	53.9	11.3
Ward No.2	87.4	3.4	0.3	94.8	5.1	0.1	0.7	0.7	54.6	45.3	0.1
Ward No.3	54.6	0.1	1.3	97.1	2.2	0.7	1.4	1.2	71.5	28.2	0.3
Ward No.4	74.2	3.5	0.3	94	6	0.1	4	0.8	62.2	37.7	0.1
Ward No.5	83.6	3.1	2	94.6	4.3	1.1	1	0.6	82.9	16.9	0.2
Ward No.6	88.9	5.9	1.1	89.4	9.9	0.7	4.1	1.1	16.4	82.2	1.4
Ward No.7	50.7	3.5	25.3	64.7	25.9	9.4	23.8	16.6	20.5	68.9	10.6
Ward No.8	59.1	1.1	9.3	83.2	14.4	2.5	10.6	10.4	67.8	23	9.2
Ward No.9	90.2	0.6	1.5	97.6	1.8	0.6	1.2	0.7	33.5	64.7	1.8
Ward No.10	98.6	0.7	0.1	98.6	1.4	0	0.2	0.1	53.2	46.8	0
Ward No.11	91.7	4.5	1.4	88.3	6.3	5.4	1	0.1	18.5	81.5	0
Ward No.12	69.1	20.5	5	90.9	6.8	2.3	3.1	0.1	22.6	77.4	0
Ward No.13	92.8	1.1	0.9	97.9	1.6	0.4	1.3	0	86.8	13.2	0
Ward No.14	96.3	1.7	0.3	93	3.1	4	4.1	3.5	45.8	52	2.1
Ward No.15	79.2	0.3	0.2	99.7	0.1	0.1	0.1	0.1	80.5	19.4	0.1
Ward No.16	66.4	26.3	4.4	41.8	21.7	36.5	20.4	17.6	3.8	91	5.2
Ward No.17	63.9	0	3.7	94.2	5.1	0.8	4	2.8	51.8	47.9	0.3
Ward No.18	74.8	5	0.9	96.8	3.2	0	2.2	2	42.4	57.6	0
Ward No.19	80.3	0.3	5.2	90.2	9.8	0	5	5	73.9	24.4	1.7
Ward No.20	70	1.1	5.5	92.5	4.8	2.7	7.3	4.1	22.4	74.8	2.8
Ward No.21	71.1	7.3	7	87	11.9	1.1	8.9	4.2	22.7	76.6	0.7
Ward No.22	67.3	4	2.2	96	3.4	0.6	1.7	1.7	21.3	78	0.7
Ward No.23	59.9	2.9	22.2	73.2	14.4	12.5	18.1	17.1	17.8	77.1	5.2
Ward No.24	94.5	0.6	0.3	99.3	0.7	0	0	0	56.6	43.3	0.1
Ward No.25	84.5	0	2.2	98.8	1.2	0	2.5	0.9	51.2	48.6	0.2
Ward No.26	72.9	1.1	0.8	96.6	2.9	0.5	1.2	1.1	50.5	48.8	0.7
Ward No.27	80.5	11.9	0	99.9	0.1	0	0.1	0	77.1	22.9	0
Ward No.28	74.7	0.3	7.7	90.8	8.6	0.7	9.3	7.8	51	46.5	2.6
Ward No.29	84.1	1.5	0.2	99.7	0.3	0	0	0	36.7	63.3	0
Ward No.30	65.9	1.1	1.6	95.1	3.6	1.3	3.3	3.1	45.5	53.3	1.2
Ward No.31	85	6.5	5.3	79.9	14.3	5.8	18.5	18.4	29.6	66.9	3.5
Ward No.32	91	1.1	3.2	94.2	5.1	0.7	6.7	4.3	32.1	64.5	3.4
Ward No.33	84	7.3	2.5	90.6	8.8	0.7	4.8	4.4	29.6	69.3	1
Ward No.34	80.2	0.5	0.3	98.3	1.6	0.1	0.4	0.4	54.2	44.2	1.6
Ward No.35	85.9	1	1.2	96.6	3.1	0.4	3.3	2.7	31.9	67.8	0.4
Ward No.36	92.4	4	1.3	94.8	5	0.2	1.9	0.2	28.7	70.9	0.4
Ward No.37	82.3	1.4	1.3	93.8	4.8	1.4	3.8	3.7	26.2	66.2	7.7
Ward No.38	92.4	0.9	2.6	92.8	6.8	0.3	10.7	2.3	40.6	58.5	0.9
Ward No.39	39.9	26.9	4.8	92.5	7	0.5	8.2	5.8	51.9	45.1	3
Ward No.40	77.8	0.2	2.4	84.4	12.3	3.3	1.2	1	17.1	82.4	0.5
Ward No.41	64.4	2.7	13.6	82.7	16.8	0.6	14.2	13.9	44.6	49.9	5.6
Ward No.42	84.2	0.1	1.9	97.9	1.9	0.1	1.4	0.2	73.4	26.5	0.1
Ward No.43	74.5	1.4	2.8	94.9	4.9	0.2	0.9	0	43.7	56.3	0
Ward No.44	77.8	0.4	6.1	87.6	10.3	2.1	7	2.6	66.8	32.9	0.2
Ward No.45	87.8	0.4	1.4	97.4	2.1	0.5	1.4	0.2	46.7	52.7	0.5
Ward No.46	89.8	7.5	1.1	84.4	12.1	3.5	8.1	0.3	49.7	49.4	0.9
Ward No.47	68.5	0.4	5.4	90.4	9.6	0	0.7	0.2	22.7	77.1	0.2
Ward No.48	79.3	0.9	3.7	92.5	7.3	0.2	7.7	0.1	8	91.5	0.5
Ward No.49	49.6	17.1	4.9	92.4	7.2	0.4	6	0.1	62.8	36.9	0.3
Ward No.50	78.9	1	1.2	89.5	10.4	0.1	6.4	0	41.1	58.5	0.4
Ward No.51	72.1	1.4	0.8	97.5	2.3	0.2	1.9	0.4	36.7	62.8	0.5
Ward No.52	80.2	0.3	0.1	99	1	0	0.1	0	48.8	51.1	0.1
Ward No.53	87.8	0.2	0.4	98.8	1.1	0.1	1.2	0	59.8	39.7	0.5
Ward No.54	78.9	2	3.9	92	6.9	1.1	16.3	14.2	49.2	48.3	2.5
Ward No.55	58.8	1.1	0.4	98.2	1.1	0.7	1.8	1.6	60.1	39.4	0.5

Figure 11: Ward level analysis of vulnerability

Table 3: Vulnerable hotspots in Udaipur city

Criteria	Number of Wards	Spatial distribution of most vulnerable wards
Lack of availability of safe drinking water (drinking water from treated sources)	7	3, 7, 8, 16,39, 49 and 55
Access to toilets	5	1, 7, 16,23 and 31
Conditions of Drainage Network System		
No drainage system	4	7, 8, 37 and 41
Open drainage system	12	6, 8, 11, 12, 16, 20, 21, 22, 23, 40, 47 and 48

Based on the ward level analysis of basic amenities, it was deduced that out of 55 wards, 20 wards of the city are highly vulnerable in terms of availability of safe drinking water supply, access to toilets and conditions of drainage network system. Most of these 20 wards are located in the outskirts of the city.

CHAPTER 10

Vulnerability assessment of children in Udaipur city

10.1 Health

Increasing summer temperature and heat waves are identified as the most direct impacts of climate change in Udaipur city posing serious health risks for communities living in the urban environment and especially for children who are more susceptible to the impacts of heat. The impact of this increasing temperature is observed as thermal stresses, such as heat exhaustion, heat cramps and dehydration. Usually, the maximum summer temperature ranges from 35° to 42° C. A significant increasing trend of 0.60° C during the last century in the mean annual maximum temperature has been observed over the city. It is projected that the annual maximum temperature will rise by 1.75° to 1.85° C by 2050. Increasing temperature badly affects the drinking water availability in summers with most severe impacts on tube-wells in the city which are responsible for providing 10.60 MLD water (CDP,

Children living near lakes, in slums and low-income settlements in the peripheral areas of the city bear the maximum brunt of increasing temperature and declining water availability

2014). These tube-wells which are dependent on the lake aquifer system have very low or negligible yield in summers when the demand is high. The children of poor and marginalised communities living near the lakes, in slums and low-income settlements, bear the maximum brunt of this increasing temperature and declining water availability. Due to lack of tap water at premises and unavailability of drinking water from the tube-wells, they directly drink contaminated water from the nearby streams and lakes leading to diseases like diarrhoea and dysentery.

The housing infrastructure of low-income group settlements like slums in the city is not adequate to protect the communities and especially infants from the increasing heat. The 39 slum pockets in the city inhabiting 9,529 households and 47,636 people have tiled or thatched roofs which are unable to block the heat. During community consultation, it was found that due to lack of resources, the children of poor communities roam around without proper clothing in the scorching summer heat. As a result of this, they get exposed to heat waves and the unhygienic open environment near their dwellings causing diseases like Dengue and Malaria (major prevailing diseases in Udaipur city, CDP, 2014) which are also known to proliferate faster in warmer temperatures. A number of government and private supported health care facilities are there in the city but the slum pockets lack any dispensaries and other primary health care facilities at their locality. They have to depend on nearby hospitals and dispensaries.

In addition, the direct impacts of elevating temperature and humidity during monsoon are associated with the increased rate of respiratory diseases among the children of Udaipur. It is projected that the annual mean maximum temperature in the post-monsoon season likely to rise by 2.0^{0} C by 2050. In such scenario, the low-income settlements having poor indoor conditions become the centres of allergies, asthma and other respiratory diseases.

The overall air quality of the city shows increasing pollution levels. The key reasons for deteriorating air quality are increased traffic, large-scale cutting of trees, deforestation along hill slopes and burning of wood and charcoal in low-income areas in the urban fringes of the city. The particulate matter concentration at Ambamata and Town Hall air quality monitoring stations crosses 400 $\mu g/m^3$ at times (ibid). Increasing temperature coupled with air pollution in the city is responsible for increasing asthma, allergy and skin diseases among the children, specifically in low-income group settlements.

Box 5: Children in Udaipur slums highly vulnerable to climate risks

"*People generally look at us with disdain*," says eleven-year-old Arjun, who works as a waste picker in Udaipur. Arjun's hands are full of wounds as he continues to scrounge with bare hands and sometimes even bare feet. His account is not just of a child making a living by picking up waste but that of the degrading living conditions in the urban slums of the city.

Rangaswamy colony where Arjun lives is a part of Udaipur city, yet it lies outside the city's municipal council's limits. Located at the foot of a hill, the colony houses about 45 to 50 families. Poor sanitation and sewerage infrastructure, pollution of the lakes and Ahar River in the city poses a huge challenge. Apart from this, Udaipur's poor solid waste management, sorry state of drainage and stormwater management add to its woes. "*Waterlogging is common and water stands up to 3 feet during monsoons in the colony*," says Ashok, a resident.

Arjun studies at the nearby high school at Badgaon. He lives in a cramped house with seven more members. The leaky roof poses a problem during monsoons. Most people in the colony are involved in begging, waste picking or labouring at a marble factory nearby. With just three family members who work for a living, Arjun was left with no option but to take to waste picking on the streets of the city when very young. He would join his parents in street scrounging, facing regular harassment by the police and at times the city residents. Now that he's somewhat grown up, every afternoon after school he goes on his own from door-to-door collecting household waste, removes all the valuable (marketable) recyclables and then dumps the rest of the trash in the local body's dustbin.

Children like Arjun end up slinging huge sacks on their slender shoulders as they scrounge places for scrap, travelling long distances, in a day. Waste picking is an extremely hazardous occupation and constantly exposes children to accidents, injuries and disease through contacts with sharp material and poisonous substances.

In Arjun's locality, most of the children are illiterate, and very few attended school. Those who did, turn drop-outs before high school. Early involvement in waste picking and apathy towards education leads to high dropout rates and illiteracy. The colony does not have piped water supply and people depend on public stand posts. People practice open defecation as none of the households have toilets.

"*Children like Arjun in Rangaswamy colony are known to be affected by the burden of diseases (heat stress, water and vector-borne like jaundice and malaria), diminishing food security and increasing malnutrition and child trafficking and labour due to loss of livelihoods of parents*," says Ashok.

It is not only their working environment that is very unhygienic and disease prone; their living environment is equally bad. Children like Arjun, thus, rank among the most vulnerable category of working children. A matter of great concern is that with urbanisation, and the increased volume of waste material, the number of such children is growing. A large number of girls and boys are not only exposed to several types of health hazards but also exposed to

the risk of sexual harassment and physical exploitation by the people around.

The present dismal state of urban basic services and livelihoods of the poor and marginalised sections, in particular of children is likely to be adversely affected further owing to climate change. While Arjun's occupation of waste picking is known to reduce greenhouse gases, and waste pickers from around the world have even represented the community at the UNFCCC conference, their plight remains unchanged in general. They offer a real solution for climate change mitigation and waste management that make economic and ecological sense, yet their living conditions remain appalling.

10.2 Education

Climate change affects the education sector directly through the increased frequency and/or severity of extreme weather events resulting in damage to educational infrastructure. The children of the poorest households are most likely to suffer the adverse consequences with regard to education. The city of Udaipur has been experiencing recurrent floods during the last one decade. The key reason to this is the insufficient stormwater management capacity of the city. The existing major drains are irregular and unlined. With inadequate capacities to carry the runoff during the storm, flooding of adjacent roads and colonies occur every year (Table 4).

Table 4: Major flood-prone areas in Udaipur city

S. No.	Flood-prone areas	Major reasons for flooding
1	Transport Nagar	-New area under development by UIT -Absence of outfall drains
2	Choti/Futa Talao	The drain coming from Goverdhan Vilas Tank is unlined in its initial stages
3	Gariawas	The drain carries stormwater from Hiran Mangri to Kachhi Basti
4	In front of DCP School, Gayatri Nagar	Two drains coming from Telecommunication colony get stagnated
5	Roadways Bus Stand	The existing drain is a lined drain in part and is covered with no provision for maintenance
6	Delhi Gate/LIC/ Collectorate	This area is the heart of the city. The existing drain is a covered drain with poor maintenance
7	Sobhagpura Abhinandan Complex	A small stretch of the drain is lined behind Bhairoji Ka Temple and is totally unlined up to Abhinandan Complex
8	Mahaveer Nagar	Both the sides of drain are encroached

S. No.	Flood-prone areas	Major reasons for flooding
9	Pancharatna Complex	Originates from Neemachmata hill slope and meets Ayad through Pancharatna Complex
10	Down Stream of Maha Satya	Originates from Abhinandan Complex and is partly lined with sidewalls in broken conditions

(Source: 'City Sanitation Plan-Draft Report-Udaipur City')

Schools situated in low-lying areas get flooded immediately during the floods and as a result, they cannot operate during the course of the floods. The infrastructure of government schools in the city is in dilapidated condition with lack of basic facilities. During rainy season most of the school buildings get seepage from the roof with a very minimal amount of rainfall and as a result of all this, access to education gets badly affected during and after monsoon period in the city.

Climate change is also impacting school attendance and educational attainment in the city through its effects on children's health and nutritional status. Quite simply, children may not be fit to learn, even when they have access to schooling. Every time there is a flood in the city, it is accompanied by a host of diseases and children are the most vulnerable to these diseases, falling sick often and sometimes with fatal consequences. During cold waves in winter, the poor children are unable to attend school as they do not have proper clothing to shield them from the harsh winter and they tend to fall sick easily. Pneumonia is the most common health issue observed during winters among the school going children of poor communities. Similarly, in summers the school going children are susceptible to getting affected by heat waves during the afternoon while returning to home from schools.

Box 4: Key governance level issues in the city for the education sector

- There are adequate numbers of higher education facilities largely provided by private institutions in the city but there is a lack of government education facilities especially primary and elementary schools.
- Sub-standard infrastructure of government schools with lack of basic services.
- A high student-teacher ratio of 1:53 is observed in primary and upper primary schools, which is higher than the preferred norm of 1:30 as per the Right to Education Act.
- A high dropout rate among girls in government schools is observed.

(Source: City Development Plan, Udaipur, 2014)

The transitional period between summer and winter with high variability in temperature is the peak time for the occurrence of diseases among children. A major proportion of inhabitants of the city are poor or from low-income groups. There assets and livelihoods are worst affected by climate change impacts in the city like floods, waterlogging, heat waves and cold waves etc. Lack of willingness to send their children to schools which in turn is a result of absence of resources, disruption of educational facilities due to climate change and disasters, ultimately ends up with the involvement of their children in domestic work or in other activities like helpers in hotels and restaurants to earn some extra money for the family. Another major cause of involvement of children in labour activities is the lack of identity proofs as the residents of the city. According to in-migration statistics of 2001 Census, the city has experienced 34 per cent rural to urban migration. These migrants are settling down in the urban slums/fringe areas of the city without any proof of identity which prevents the school admission of their children and thereby affecting the right to education.

10.3 Nutrition

Diminishing food security and malnutrition among the urban poor children are the key concerns for the city associated with climate change impacts. Climate change is affecting food security in complex ways. The impacts on primary sector activities including agriculture, livestock rearing and horticulture are notable causing grave social and economic consequences in the form of reduced incomes, eroded livelihoods, trade disruption and adverse health impacts. The production from primary sector is being affected due to diminishing water availability and depleting soil quality which in turn is a result of scanty and irregular rainfall conditions and higher evapo-transpiration rates from surface water bodies which are the major sources of water for the city.

Decrease in the food production compels the inhabitants to have an unbalanced and poor diet due to lack of awareness about the nutritious food for healthy living. On the basis of historical data, it has been found that the frequency of occurrence of droughts in Udaipur is once in every 6 years. Multiple effects of droughts are observed among the poor urban families and especially on the children who are the most vulnerable to these impacts. The food shortages during droughts cause nutritional deprivations which has immediate and lifelong impacts on children.

The slum settlements in the city have poor indoor and outdoor hygiene conditions which further drops down during floods and waterlogging in the locality. The livelihoods of labourers, vendors, petty shopkeepers get affected and they do not get proper wages forcing their families to skip meals affecting their nutritional status for a long time. Women are specifically affected due to rising daytime temperature of the city as they are unable to go to work, their capacities are reduced which directly impact their income levels and intake of food. This imbalanced diet is causing malnutrition and anaemia among mothers which in turns affects the infants taking mother feed. During community consultation in slum households, it was observed that during floods, waterlogging and drought conditions in the city most of the dwellers are unable to take proper diets having fats, minerals, salt and micro-nutrients which are the essential part of a balanced diet. Due to lack of proper education and awareness about balanced and hygienic diet, unhygienic food intake habits are developed among their children. All these results in protein-energy malnutrition, mental retardation due to lack of iodine intake, birth defects due to malnourished mothers and repeated infections due to unhygienic food and greater susceptibility to diarrhoea, T.B. and many other gastrointestinal diseases.

10.4 Water, Sanitation and Hygiene (WASH)

The entire state of Rajasthan is already a water deficit state and the availability of freshwater is predicted to further decrease with scanty and irregular rainfall conditions which are expected to rise. This decreasing water availability is affecting the quality of water in the state leading to high Total Dissolved Solids (TDS), high salinity, fluoride and nitrate contents in water. The water quality further decreases in summers due to increase in temperature which causes increased evapo-transpiration. It is predicted that a 1 per cent increase in temperature from the baseline data could result in an increase in evapo-transpiration by 15 mm, resulting into additional water requirement of 313.12 mcm for the entire arid zone of Rajasthan (RSAPCC, 2010).

Through stakeholder workshop and community consultation, it was found out that increasing salinity and TDS is leading to digestive problems among poor children as they directly consume water from the nearby sources like tube-wells, hand-pumps and open streams. High calcium carbonate content is found to have adverse impacts on children's bones and joints by

calcification. Similarly, higher fluoride content in freshwater resources of the city is leading to early decay of teeth among children. Due to excessive use of chemical fertilizers in the crops, the nitrate concentration in the water, especially in the lake water which is being supplied for drinking purpose in the city is increasing and it is further getting worse due to higher evaporation rate in summers.

The peripheral areas of the city lack proper irrigation infrastructure. Due to depleting groundwater resources with less rainfall and recharge, the farmers in the peri-urban areas are using untreated sewerage water for irrigation which becomes the entry point of pathogens in our food cycle adversely impacting the health in long-term. The sanitation infrastructure in the city is not in a very good condition. Most of the lakes in the city are in danger of incorrigible degeneration due to untreated sewerage dumping. The largest lake in the city, Lake Pichola with a capacity of 13,677 million litres is contaminated with E-Coli bacteria sourced from human excreta through the sewer. The city lacks an integrated underground sewerage system. Only 440 ha of the city area is sewer covered which is less than 10 per cent of the total city area (CSP, n.d.). In the rainy season, prolonged drainage congestion occurs due to irregular and unlined drains and choked and malfunctioning vents of the cross drainage works. Due to lack of proper infrastructure, unhygienic conditions evolve in the slums and congested settlements particularly in monsoon season leading to vector and water-borne diseases among children.

Six persons, including five children, died due to complications related to diarrhoea and dysentery after consuming contaminated water in Gogunda area of Udaipur in the past one week.

'6 die due to contaminated water in Udaipur', The Times of India City, Jaipur, 5 September 2016, <https://timesofindia.indiatimes.com/city/jaipur/6-die-due-to-contaminated-water-in-Udaipur/articleshow/54010785.cms>, accessed 8 October 2017.

Udaipur has a high incidence of water- borne diseases like typhoid, paratyphoid, amoebic dysentery, colitis, diarrhoea and viral hepatitis, seen most widely among the 60,000 people living around the lakes.

Rakhee Roy Talukdar, 'Lake city faces part pooper', The Telegraph, Udaipur, 29 March 2015, <www.telegraphindia.com/1150330/jsp/nation/story_11597.jsp>, accessed 8 October 2017.

Open defecation among poor slum dwelling communities is another major issue affecting human health, especially children due to their weak immune system. A large number of slum dwellers of the city i.e. 1,702 households (CDP, 2014) perform open defecation in surrounding vacant and agricultural lands. The slum dwellers living near the railway line use the tracks for defecation (CSP, n.d.). Only 55 per cent of households have access to drinking water and toilet facilities. It has been found that open defecation is the major reason for diarrhoea among children. Children weakened by frequent diarrhoea episodes are more vulnerable to malnutrition, stunting and opportunistic infections such as pneumonia[10].

With the existing conditions of WASH facilities in the city, increased waterlogging and flooding in future due to greater climate variability may affect the community toilets and unimproved sources leading to a significant rise in diarrhoeal diseases, infant mortality and greater transmission of diseases through the water due to warmer temperature. Potential impacts of climate change can thus be expected to become an additional stressor for the city and health sector which may increase the risk of exposure to vector-, water- and food-borne diseases, aggravate malnutrition and increase mortality and morbidity associated with changes in intensity and frequency of extreme events.

10 UNICEF India, 'Eliminate Open Defecation', <http://unicef.in/Whatwedo/11/Eliminate-Open-Defecation>, accessed 18 November 2017.

10.5 Child Protection

The children of poor families, especially the cultivators and agricultural labourers whose livelihoods are affected by low productivity or crop failure due to climate change are encouraged to work in small hotels, restaurants, as petty vendors and as domestic help to support their family. The children of excluded families living in the outskirts of the city are engaged in begging without proper clothing which increases their exposure to heat/cold waves and infectious diseases. There are a significant number of people from the other parts of the state and adjoining states living in the fringe area of Udaipur city. They live in slums without access to basic services like safe drinking water and toilet facilities etc. In summers, high temperature and lack of resources in their congested settlements force them to sleep on the roadside at night where the physical safety and protection of their children is always at stake. The children sleeping on roads are highly vulnerable to accidents. There is always a fear of child abduction and trafficking from these areas.

Unemployment among poor communities caused by climate change impacts is also related to household debts and alcoholism. The culture called *Nata Pratha*- where children are left as orphans is becoming more prevalent in the city with the breakdown of family relations.

Child labour in the city emerged as a matter of grave concern through community consultations and the stakeholder workshop. The children from slums areas are appointed as labours through middlemen to work in industries having horrible hygiene conditions with a polluted environment such as plastic, marble cutting and, polishing industries etc. These types of industries are very common in the areas like Nai, Sisarma, Sobhagpura, Kherwara, Jhadol and Panarwa.

Every year in rainy season many children from poor communities of Udaipur are sent to Gujarat to work as labourers in the fields of Bt Cotton. They work in the fields for sowing Bt Cotton in monsoon, artificial pollination and then till the harvesting of Bt Cotton, they work for around 5 months. Recently, 15 children have been rescued by Panvara police who were being taken to Gujarat from Udaipur to work in the Bt Cotton fields. These children are paid only Rs. 100 to 120 per day which is much less than the amount paid to an adult[11]. Children in the fields have to work in torturous environments, where they work from 4 a.m. till 2 p.m. harvesting cotton while standing in ankle-deep muddy water[12].

Child labour snatches away their right to education and the work environment in unsafe industries forces them to indulge in bad habits like addiction to liquor, smoking, drugs which eventually change their mental conditions and behavior making them more violent and abusive. The parents are also not concerned as they lack resources to look after their families and they are ignorant of the rights, protection and safety of children due to lack of education and awareness.

11 Monika S, 'Child labour act – 15 children rescued', UdaipurTimes.com, 18 July 2017, <https://udaipurtimes.com/child-labour-act-15-children-rescued>, accessed 9 November 2017.

12 IANS, 'Tender years blighted in Gujarat's cotton fields', The Hindu, Jahdol, Rajasthan, 1 July 2014, <www.thehindu.com/todays-paper/tp-in-school/tender-years-blighted-in-gujarats-cotton-fields/article6164161.ece>, accessed 10 November 2017.

CHAPTER 11

Resilience actions

Through this vulnerability assessment it has been found that the following groups of children are the most vulnerable to the impacts of climate change and disasters in Udaipur city:

1. Children in slum settlements
2. Children in fringe areas
3. Children living near water bodies in slum-like settlements
4. Children at tourist places who are mostly involved in begging
5. Floating population of children (Climate change-induced migration)

The following table depicts the resilience actions based on the children's vulnerability and development deficit in the city:

There is a need to build the capacity of the local government and institutions through special programmes focusing on "Urban Resilience Building" while addressing the specific vulnerabilities of urban poor children

Table 5: Children-focused City Resilience Actions

Sector	Children's Vulnerability	Development Deficit	Needed Actions	Policy/ Programmes	Institutions
Health	- Heat Stroke (Loo) - Water-borne diseases: Typhoid, Hepatitis, Jaundice, Diarrhoea, Dental and Skeletal Fluorosis - Vector-borne diseases: Malaria, Dengue - Respiratory diseases: Asthma, Allergies - Flu and Swine Flu - Skin diseases: Eczema, Dermatitis	- Inadequate solid waste management system - Lack of an integrated underground sewerage system - Poor coverage of sewerage network in the city - Inadequate sewerage treatment facilities - Increasing air pollution (increasing traffic, degradation of green areas, coal and wood burning in low-income settlements) - Degrading urban and peri-urban natural ecosystem containing lakes, hills and green areas - Usage of sewerage water for irrigation of vegetable crops in peri-urban areas	**ENVIRONMENT AND HEALTH** - Plantation drives in the city and peri-urban areas with community engagement - Provision of adequate irrigation infrastructure in peri-urban areas - Reforestation around the city in the Aravalli Hills - Conservation of the Girwa Hills - Considering modification in the school timings to avoid heat strokes among school going children (Time and Days Modification-April and May should be vacation months) - Provision of adequate facilities at Urban Health Care Centres and Government Hospitals (equipment, medicines, staff skill up-gradation and patient counselling etc.) - Real-time air quality monitoring system in the city - Increasing anti-malarial and anti-dengue drives in identified disease hotspot areas of the city - Fogging in extended periods **HOUSING** - Heat resilient shelter arrangements for homeless children - Promoting green and cool roof low-cost technologies, especially for low-income settlements **SEWERAGE/DRAINAGE/SOLID WASTE MANAGEMENT** - Development of an integrated underground sewerage system covering all the left-over areas of the city - Repairing the existing drainage system - A technology-oriented solid waste management system of the city with 100 per cent door to door collection and management - Proper monitoring and evaluation of effluent treatment plants (ETPs) and efforts to increase the treatment efficiency and capacity - Strict enforcement of pollution control laws to prevent discharge of industrial pollutants in the Ayad river **DRINKING WATER** - Replacing the old water supply pipelines with ductile iron pipelines - Strict enforcement of laws for rainwater harvesting **CAMPAIGNS AND AWARENESS** - "Clean and Green City Campaign" and related activities to curb air pollution (increasing share of public transport, phasing out diesel vehicles and promoting renewable energy) with children's engagement - Inculcating good practices (drinking more water, wearing fully covered cotton clothes, headwear, etc.) in children against heat protection through school curriculum and heatwave awareness drives in the city	- Shelter for Urban Homeless - Building Bye-Laws - RSAPCC - RSDMP - Smart City Project - National Lake Conservation Plan - PMAY - AMRUT - Municipal Solid Waste Management Rules, 2016 - Mukhya-mantri Jal Swavlamban Abhiyan (Government of Rajasthan)	- Medical Health and Family Welfare Department, Government of Rajasthan - District Medical Health Office - UMC - Urban Development and Housing Department, Government of Rajasthan - UIT - Forest Department - PWD - PHED - Agriculture University - Disaster Management Department - Education Department - District Administration - SPCB - CPCB - SCERT - NGO - Civil Society Organizations (CSO)/NGOs/ International Non-Government Organizations (iNGOs) - Corporate Social Responsibility (CSR) activities

Sector	Children's Vulnerability	Development Deficit	Needed Actions	Policy/ Programmes	Institutions
			- Awareness among communities and children on the prevention of emerging diseases due to climate change - Implementing water quality monitoring mechanisms in schools and related IEC campaigns for awareness building		
Education	- School dropout in slum children - Absenteeism due to extreme temperatures - Absenteeism due to involvement in labour activities - Behavioural issues (Gender Bias) - Increasing seasonal diseases and irregularity in school	- Inadequate number of primary and elementary schools - Poor maintenance of existing school infrastructure - Flooding of schools and nearby areas due to insufficient drainage management system - Inadequate basic services at school level-drinking water, toilets and hand wash water etc. - Lack of awareness among parents about the importance of education, especially for girl child resulting in high drop- out rate - Disinterest in education due to lack of employment opportunities - No special provisions for the education of migrant children	**SCHOOL SAFETY AND MANAGEMENT** - Construction of new disaster resilient school buildings - Retrofitting of existing school buildings against climate change and disaster impacts with up-gradation of necessary infrastructure facilities and adequate staff - Formation and implementation of "School Safety Plan" at individual school level - Formation of "School Management Committee" to implement and monitor the above actions actively **EDUCATION MANAGEMENT** - Incorporating climate and disaster resilience components in the school curriculum and pedagogy with a gendered approach - Creating awareness among students about climate change and disasters through debates, competitions, songs, dramas and eco-club formation - Orientation of school teachers on different aspects of climate change and disasters through some Refreshment/ Orientation/Training Courses (Vulnerability Assessment and School Disaster Management Plan Preparation) - Awareness programmes/counselling of parents (especially for low-income groups) on the importance of education and physical and mental health of their children - Formation of "Climate Watch Children Groups" - Smart Classrooms in Government Schools to encourage children to attend schools and decrease dropouts and absenteeism - Special campaigns for migrant children/ scattered population (enrolment, counselling and other essentials) - Provisioning of information education system for slum children - Promoting good health and sanitation practices by organising regular health check-ups in schools	- Rajasthan Madhyamik Shiksha Abhiyan - School Safety Policy, 2016 - Sarva Shiksha Abhiyan - RSAPCC - RSDMP - Smart City Project	- UMC - Education Department - Rajasthan Council for Elementary Education - PHED - DDMA - SDMA - SCERT - DIET - Rajasthan Board of Secondary Education - CSOs/NGOs/ iNGOs - CSR activities

Sector	Children's Vulnerability	Development Deficit	Needed Actions	Policy/ Programmes	Institutions
Nutrition	- Malnutrition (Protein-Energy Malnutrition) - Mental Retardation - Iodine Deficiency - Birth Deficiencies - Repeated infections, diarrhoea and vomiting	- Agricultural production and diversity losses (rural-urban connect) - Non-availability of a balanced diet to urban poor communities - Unhygienic food intake practices in the absence of any awareness and resources for consuming nutritious food - No security of wages for daily wage workers affecting their family health and nutrition - Congested settlements create an unhygienic environment which increases the susceptibility to diseases leading to malnutrition in the long-term	**POLICY/PROGRAMMES/SCHEMES** - Creating more livelihood opportunities/ diversification in employment sources for lower socio-economic classes - Strengthening the existing nutritional schemes and the programmes run by the government in terms of implementation, technological up-gradation and monitoring of impacts - Contextualizing ICDS programme for identified nutritional deficiencies - Evolving an efficient nutrition management and surveillance system, especially for the vulnerable groups - Increase the access of nutrition-related support services to the marginalised families - Providing affordable housing to economically weaker sections and making them aware of the existing government housing schemes **AWARENESS** - Educate and mobilize families to grow locally available foods in their courtyards/ kitchen gardens/terrace gardens - Awareness on a balanced diet with suggestions for local food options and management of household resources for food security - Generate awareness on consuming the available food hygienically. Parents need to be educated on these issues, specifically, the mother who plays an important role in a child's nutritional status **ECOSYSTEM CONSERVATION** - Conserving the degrading ecological resources in and around the city through community-based programmes - Promoting climate and disaster resilient agricultural practices in the peri-urban areas	- Pradhan Mantri Fasal Bima Yojana - Annapoorna Rasoi Yojana, Government of Rajasthan - Nand Ghar Yojana, Government of Rajasthan - National Nutrition Mission - Mid-Day Meal - ICDS - RSAPCC - National Skill Development Mission - PMAY - AMRUT	- UMC - Agriculture Department - Department of Women and Child Development, Government of Rajasthan - Department of Health and Family Welfare, Government of Rajasthan - Urban Development and Housing Department, Government of Rajasthan - UNICEF - CSOs/NGOs/ iNGOs - CSR activities
WASH	- Water-borne diseases: Typhoid, Hepatitis, Jaundice, Diarrhoea, Dental and Skeletal Fluorosis	- Lack of potable water due to high TDS/fluoride (specifically in areas like Khara Kuan and Jaishree colony) - Inadequate coverage of the water supply system - Inadequate maintenance of the existing water supply system resulting in huge distribution losses - Inadequate drainage and stormwater management system - Pollution of drinking water resources due to mixing of raw sewerage - Increasing nitrate concentration in lakes due to agro-fertilisers and sewerage mixing	**DRINKING WATER** - Increasing the water supply coverage and treatment facilities in a planned and technology-oriented manner and ensuring its proper operation and maintenance - Conservation of traditional water resources and promoting the conjunctive use of water with adequate groundwater recharge mechanisms in place - Initiate city-wide programmes for citizens' and stakeholders' participation in the management of lakes - Localized treatment of drinking water at home and at schools - children to be oriented on this at the school level - Strict enforcement of pollution control laws for solid and liquid waste disposal in water bodies - Extensively promoting and incentivizing rainwater harvesting at premises, school and other public and government buildings - Provision of water ATMs to provide potable water, especially in low-income settlements	- RSAPCC - Smart City Project - National Lake Conservation Plan - PMAY - AMRUT - Mukhya-mantri Jal Swavlamban Abhiyan (Government of Rajasthan)	- UMC - UIT - PHED - Urban Development and Housing Department - Water Resources department, Government of Rajasthan - Central Ground Water Board - SPCB - CPCB - Education Department - CSOs/NGOs/ iNGOs - CSR activities

Sector	Children's Vulnerability	Development Deficit	Needed Actions	Policy/ Programmes	Institutions
		- Encroachment and degradation of catchment areas of lakes - Inadequate sanitation infrastructure (especially for low-income settlements) leading to open defecation - Lack of awareness among communities (specifically slum areas) on good hygiene practices - Declining groundwater table in absence of adequate recharge mechanisms	**HEALTH AND HYGIENE** - Creating awareness among children on good hygiene practices through school curriculum and programmes - Construction of adequate number of community toilets with the proper discharge of waste - Assessment of infrastructural gaps in the public and community toilets- specifically at open defecation spots **SEWERAGE/DRAINAGE** - Adequately functioning STPs and ETPs in the city to prevent contamination of drinking water sources - Develop decentralised wastewater treatment systems in the city for promoting the use of recycled water for low-end use		
Child Protection	- Child trafficking - Child labour - Begging - Child Marriage - Drug addiction - Extreme weather events are a threat to child safety, especially for homeless children - Accidents due to school building collapse, open drains - Desertion (*Nata Pratha*, Changing relationships)	- Poor construction and maintenance of old school buildings - Changing family relationships and affection towards children due to increasing stress, which in turn is a result of disruption of livelihoods due to climate change - Stagnated work opportunities for marginal jobs in the core city area - Lack of awareness among parents and children on issues of self- safety and protection, laws, rights and entitlements of children	**ENFORCEMENT** - Strict implementation and monitoring of Building Bye-Laws, especially for schools - Strict enforcement of laws relating to child safety and protection - Strict enforcement of laws to arrest gender imbalance - Strict enforcement of the provisions of 86th and 93rd Constitutional Amendment Act (CAA) of Article 21-A (free and compulsory education up to 14 years) to make sure that every child attend the school and prevent child labour **SAFETY AND AWARENESS** - Regular cleaning of drains and covering the open drains - Linking every child to Aadhaar to ensure protection - Awareness among parents and children on child safety and protection issues - Psychosocial trauma management trainings for children at school level by trained counsellors - Mapping of schools in child labour intensive areas and hard to reach areas with the support of ULB and CSOs **PROGRAMMES/POLICIES/SCHEMES** - Developing and implementing "Child Protection Policy" at School level i.e. in the school processes and curriculum. (Behavioural change, more teacher-student interaction, enhanced quality of education and fewer drop-outs leading to less child exploitation) - Livelihood diversification opportunities for marginal workers/wage labourers in the city to avoid family distress and violence against children - Preventing child labour through multi-stakeholder approach involving government, NGOs, private sector, communities, employers and workers (poverty-focused programmes) - Increase the outreach of night shelters - Formation of special security agencies in the city for the children who have become orphan in the course of disasters or are abandoned by their families - Monitoring of children and youth in the migrating and floating population	- RSAPCC - Integrated Child Protection Scheme - National Plan of Action for Children - National Child Labour Project - Smart City Project - National Plan of Action for Children, 2016	- UMC - Women and Child Development Department, Government of Rajasthan - Department of Social Justice and Empowerment, Government of Rajasthan - Rajasthan State Commission for Protection of child Rights - Disaster Management Department - Education Department - Childline - Child Welfare Committee - Labour Department - Police Department - CSOs/NGOs/ iNGOs - CSR activities

Apart from the above mentioned resilience actions based on children's vulnerabilities and development deficit in the city, there are some cross-cutting issues of planning and governance, which need to be addressed for effective implementation of the resilience strategy:

1. 'Hazard, Risk, Vulnerability and Capacity Analysis' of the city should be done to identify ecologically sensitive hotspots
2. Developing 'City Resilience Plan' with the help of this initiative to integrate vulnerabilities of children
3. Establishment of a 'Climate Cell' in UMC to integrate climate change aspects in DRR
4. Formation of a 'City Advisory Committee'
5. Participatory Ward Level planning (74th CAA)
6. Developing 'Departmental Plans' on Child-Centered Climate Smart DRR
7. Inter-departmental coordination between various line departments with mainstreaming of the issues concerning UCCR and children specific vulnerabilities in their working agenda
8. A strong political will to identify and implement resilience measures
9. Involvement of communities and CSOs in the implementation process
10. Last but not the least, all the above-mentioned actions can only be achieved through a proper finance and capacity building process. Often the new and progressive plans and schemes are vetted on the question of financing them. More often it is seen that after the challenge of lack of mandates and policies, cities and regions face problems in financing their resilience plans. Also, there is less capacity in the local bodies both technical and financial to support some of the activities outlined in the resilience strategy that is multi-dimensional and multi-sectoral in nature. However, with planned efforts and involving local expertise and academic institutions and support from the state level expert agencies, regular and planned capacity building can be achieved in medium to long-term time horizon. Besides, this integration of resilience parameters in infrastructure design and land-use planning will lead to the preparation of detailed project reports that already account for resilience and will not overburden the city finances with additional financial requirements. The city must also update its financial management mechanisms and revenue streams to be able to update and improve its financial capacities.

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