Urban Climate Change Resilience

POLICY BRIEF 6

Economic Resilience of Cities in a Changing Climate

Adaptation to climate risks is an emerging concern in Indian cities. The evidence generated so far suggests that Business as usual is not an option for urban economic resilience in the context of a changing climate.

KEY MESSAGES

- Wide variation in the results of climate models is one of the most important causes of resistance towards investments in climate action (both mitigation and adaptation), especially in the face of everyday realties of decision making about more tangible and pressing requirements, such as those for urban services and infrastructure.
- Differences in climate consciousness between gradual and sudden onset impacts of climate risks shape adaptive responses – at the city level as well at the level of individual firms and establishments.
- Prudent investment as well as good governance is key to better adaptation. A city's preparedness determines the extent of its 'exposure' to climate related risks. Resilience can be augmented both through proactive policies as well as by smart infrastructural investments.
- Strategic and smart investment in low carbon transportation and water networks, and ensuring their security, is crucial to urban resilience. Effective land use and energy demand management are additional elements of resilient growth.
- A city's spatial structure can shape its economic and environmental efficiency. Compact cities are considered low carbon and climate safe. However, the benefits of mixed use, compact, high FSI, dense cities via a smaller ecological and transportation footprint are not automatic. Supportive policies (such as transit oriented development and adequate green cover) are needed to overcoming diseconomies of urban density and negative ecological externalities.
- A city's economic and climate security cannot be limited to city (municipal) boundaries: food, water and mobility security depend upon key urban, peri-urban and rural linkages. Urban adaptation mechanisms, in order to be effective, need to extend beyond the city limits to other nested spatial, administrative and institutional scales. Collaboration, relational governance, and collective action between neighboring and regional institutions will be important.

- Rising temperatures have a significant negative impact on worker productivity. On high temperature days, national level manufacturing data show that there is a loss of output of on average 2 percent per degree Celsius. The losses are highest in high value segments of the industry. In the case of Surat, based on firm level evidence from the weaving industry, the losses can be as high at 4.2 percent per degree Celsius on the hottest summer days.
- Cities face an increased risk of disease in the facing of rising temperatures and humidity. Results show that the benefits of adaptation or per person costs saved (including losses averted), when aggregated across the exposed population city-wide, outweighs the cost of adaptation.
- Business as usual is not an option to attaining urban economic resilience in the context of a changing climate. Innovative, adaptive policies that foster climate safe growth are critical, as are strategic investments, supportive institutions and smart legislation.

1 THE URBAN CHALLENGE

The world is urbanizing at a pace never seen before. About a billion urban residents are being added to the globe every thirteen years[1], and a majority of them are in China and India. Urban areas generate more than 90 percent of the global economic output, accommodate over half of the world's population, consume more than 65 percent of the world's energy, and account for 70 percent of global greenhouse gas emissions.[2]

India is one of the world's emerging urban hotspots. In less than twenty years nearly 60 percent of the country's population is likely to be urban. Cities are already the engines of national economic growth. This economic role of cities will only intensify in the future. In less than twenty years (i.e., between the 12th and 15th Five year Plans), more than 75 percent of GDP and 70 percent of jobs are projected to come from cities.[3] As urban populations grow, huge new demands are being created for housing, transportation, energy, jobs and basic services. Managing these demands, and the urbanization process, at a scale and pace such as this is a paramount challenge facing policy makers today.

The challenge is not only to efficiently manage scarce urban resources to provide needed services in the face of rapid urban growth. The challenge is to also factor in the risks that can undermine this growth. Cities, with their high population densities, intense energy use, and inbuilt social and economic inequities (e.g., large numbers of poor, migrant and vulnerable populations) not only generate costly ecological externalities (e.g., GHG, pollution) that contribute to climate change, but urban agglomerations are disproportionately exposed to the risk of extreme events and the pressures of climate change: namely rising temperatures, uncertain and intensified precipitation, and sea level rise. Urban assets such as roads, housing, water systems, commercial and industrial infrastructure are costly and long lasting assets – once implemented, these investments are locked in place for decades. Planning them with climate risks in mind is key to their sustainability.

The uncertainty around climate risks and a lack of clarity about the claims makes the risks seem distant and vague. But as the enormously high human and economic costs of climate linked extreme events such as Typhoon Haiyan in the Philippines, Hurricane Phailin and the Mumbai floods in India and Hurricane Sandy and Katrina in the United States demonstrate, the threats are real and far closer than they might seem. Indeed, recent estimates show that the costs of not addressing the climate and environmental challenges India faces (i.e., by following the business as usual strategy) are high. They amount to a 5.7 percent reduction in GDP, or a loss of $80 billion per year (Mani, World Bank 2013).[4]

The central message thus is that the manner in which governments plan and manage the urbanization process, how they deal with the twin challenges of growth and climate security, will fundamentally shape the sustainability of national economic growth and competitiveness. Climate safe urbanization is not an inevitable tradeoff with economic growth. It can complement the growth process, enhance productivity, human health, asset creation and public safety.[5] Research that is currently underway (ours, and others like ours) seeks to understand the conditions under which a climate responsive urbanization process can deliver both resilient economic growth as well as climate security.

1 Fragkias M, Lobo J, Strumsky D, Seto KC (2013), "Does Size Matter? Scaling of CO2 Emissions and U.S. Urban Areas." PLoS ONE 8(6): e64727. doi:10.1371/journal.pone.0064727

2 Solecki, William , Karen C. Seto & Peter J. Marcotullio (2013) It's Time for an Urbanization Science,Environment: Science and Policy for Sustainable Development, 55:1, 12-17, DOI: 10.1080/00139157.2013.748387

3 United Nations; McKinsey Global Institute, 2010, India's Urban Awakening: Building Inclusive Cities, Sustaining Economic Growth. http://www.mckinsey.com/insights/urbanization/urban_awakening_in_india.

4 M. Mani, (2013), Diagnostic assessment of select environmental challenges, the World Bank, Greening India's Growth.

5 This is the current focus of the new generation of research on climate sensitive urban and economic processes. See The Global Commission on the Economy and Climate, ACCCRN, WRI, World Bank (Greening India's Growth) and researchers such as Carmin, Berke, Seto, Solecki, Batty, Susskind among others.

2 CITY LEVEL ADAPTATION: WHO IS MOST LIKELY TO ACT ON CLIMATE CHANGE AND UNDER WHAT CONDITION?

Our study focuses on four secondary cities in India – Pune, Surat, Kochi and Ludhiana – to understand the conditions under which climate security, adaptation and economic resilience can go hand in hand. Our focus on tier two cities is deliberate. They are the fastest growing urban centers in India where city managers and planners are making decisions every day about where to site key infrastructure in the city, water systems, power grids, transportation systems, and zoning land for industrial, residential and commercial activities. Where this development occurs and how and to what extent infrastructure decisions accommodate climate threats (e.g. the size of a storm water drainage pipe, its location and materials, or the elevation of land on which housing is built, the structure of urban form), can play a key role in the effectiveness of these long lasting, relatively irreversible, assets, and consequently the economic resilience and competitiveness of these fast growing urban areas.

What are the climate risks facing these cities?

Our analysis of available data (channeled through a cluster of models) suggests that Surat's key climate risks over the next forty years include a warming trend (2-3°Celsius increase) of winter minimum temperatures. Coupled with high humidity (>55%) levels, this could increase the disease transmission window in the region. A broad average of six models predicts a fall in total precipitation. At a local level this would have an implication for ground water levels and water storage. At a more macro level, water supply risks for the city emanate primarily from changes in Tapi river water flows.[6]

For Kochi the projections show a sharp rise in total precipitation with an overall increase in heavy rain days (>10mm). The variation in rainfall visible in lesser months with the April to June period showing a fall in rainfall and the monsoon months (July-October) showing an indubitable rise. The precipitation changes are expected to affect agriculture yields, hydropower potential as well as industrial supply chains. Coupled with drainage and sanitation inadequacies, it could lead to increased water & vector-borne diseases as well. Thought Kochi is sheltered by a gentle continental shelf, large areas of Kochi could be inundated by sea level rise with the inundation exacerbated by the existence of backwaters and an elevation in many parts just 1.5-3m above sea level. It has been estimated that with a one meter rise in sea water approximately 169 sq.km. of land may get submerged. Similar figures for two meter rise are much higher at 599 sq.km.[7] Salt water ingression could lead to groundwater contamination of existing aquifers. This could aggravate the city's water supply woes and negatively impact tourism revenues. Submergence of neighboring islands (Goshree Islands) could also lead to distress-induced in-migration.

In the case of Pune the available data project an increase in precipitation but with large variations across model results, and broadly a fall in monsoon rainfall but a post-monsoon increase. In addition to human settlement impacts, the possible environmental impacts could degrade the Sahyadri biodiversity hotspots as and lead to storm runoffs. Since the city is dependent on the Mula-Mutha river for water supply, precipitation changes would affect water volumes as well. Water volume forecasts for the river based on PRECIS results, show a fall.[8]

Given these risk projections, who acts on climate risks and why?

Result 1: Uncertainty in Climate Science and Downscaling to City Scales as a Source of Resistance to Climate Action

- *Uncertainty in climate science is one of the most important causes leading to resistance by many public and private economic agents towards investments in climate action (both mitigation and adaptation). The discussion of outcomes is still, naturally, in terms of probabilities. Wide variation in the results of climate models compounds this uncertainty. This variation stems from differing socio-economic trajectories chosen as inputs as well as variations in specific climate parameters used in the different models.*
- *This uncertainty when pitted against the everyday realties of decision making about more tangible and pressing requirements, such as those for urban services and infrastructure, loses its pertinence for policymakers. It is thus not surprising that many policymakers think of climate change as a distant thing, decisions about which need to be taken 'sometime in the future.'*

More importantly, there is a paucity of data and expertise at an urban local level on developing/engaging with details of city specific climate models. While at a national level, there is a growing emphasis on the urbanization process, and infrastructure investments in particular, clarity on how climate impacts impinge on cities is lacking. A positive step in this regard would be to provide incentives to states, such as tying JnNURM funds, to encourage the preparation state level climate plans (SAPCCs). Even though downscaling of these results at a city level is still quite

6 University of Cape-Town Climate Information Portal (2046-2065) and MoEF's PRECIS model for the 2030 projections.
7 Ibid
8 Ibid

rare, and the local capacity of engaging with climate models remains largely concentrated in academic circles, fresh inducements to foster university-government collaborations, or university-industry collaborations could help bring this knowledge into the public and planning domain in a more accessible and applied manner. Cities in the United States offer many good examples of how locally based university-government-community collaborations can generate innovations.

Result 2: Differences in Climate Consciousness between Gradual and Sudden Onset Impacts Shapes Adaptive Responses

Our case comparisons show that cities with experience of repeated sudden onset, climate-related extreme events are more amenable to climate action. In these cities (e.g. Surat in our case) there is both a pragmatic and a normative acceptance of the need to respond on the part of government as well as citizens. In these cities we found that having engaged frequently with disaster management, environmental legislation, funding set-asides and land-use changes, local institutions and urban local bodies had built up their internal capacity to deal with environmental challenges as a part of their development agenda, and thus are more open to planning for climate preparedness. The transition to climate responsive planning was easier.

By contrast, in cities with gradual onset of climate impact, policymakers are often caught unawares of the emerging problems. To illustrate, the submergence of the low-lying areas of Mattancherry and Fort Kochi during monsoons is not new and local residents have become acclimatized to flooding during some months of the year. However, a recent phenomenon observed by city dwellers is the increase in incidences of extremely heavy rainfall. Having schools shut off due to rain (rain holidays) is a new trend in the city, not only because of the intensity of the rainfall, but also because schools serve as temporary shelters for the poorest and homeless during these episodes. Thus, gradual onset of climate impacts leads to surprises when policy makers are confronted with an escalation of a known hazard. This leads to a much more costly adaptation process for the city after the fact. For town planning departments that envision city developments plans only 20-30 years out, gradual climate impacts lead to many investments being stranded and the rest being stretched beyond their capacity, because misplanned urban assets are already locked in place. Climate aware, strategic planning today can thus pay dividends not only in the short run, but also lower the cost of adjustment in the years to come.

Result 3: Prudent Investment as well as Good Governance are Key to Better Adaptation

It is well known that climate impacts are likely to vary between cities based on their location and geography. While this is the hazard side of the story, the actual impact on the people or 'exposure' of the city is a key factor in the city's preparedness. This preparedness or resilience can be augmented both through proactive policies as well as by smart infrastructural investments.

A common perception is that climate investment is an additional burden on local government budgets. This may arguably be true in the case of mitigation which involves additional costs of renewable installation, and efficiency improvements through investment in new technologies and so on. However, this need not be the case for adaptation. There are many cases in which complementarities between providing urban services and climate resilience can be exploited, and therefore bundled. To illustrate, Pune gives 10 percent exemption on property tax for new construction that incorporates either solar panels of certain specifications, or rainwater harvesting, vermicompost pits, sewage treatment Plants (STPs) and so on. Of these options, rainwater harvesting serves the twin benefit of providing an additional water source as well as improving the water security of the city through conservation in the face of climate projections of declining precipitation for the city. Thus, at a more macro level adaptation requires not necessarily doing different things, but doing things differently. Solar panels can similarly provide co-benefits through energy efficiency, reduction in Green House Gas (GHG) generation, and adoption of a lower carbon growth path.

With regard to climate governance, there needs to be a careful balance between a strong administrative wing at the city level (top down championing of climate adaptive development) and large-scale people's participation at the local level. On the one hand, a strong bureaucratic system can take actions quicker in times of crisis but would not take into account the voices of the various sections of society. Attracting privately funded climate investment, or buy-in may likely be difficult in this case. However, on the other hand, having an extremely consultative system that has public participation at every stage, while desirable, makes climate investment a long-drawn process that may increase project costs as well. Each city will work out its own (evolving) balance from the ground up, based its own political economy and institutional structure. In our cases Surat provides an example of a progressive, far-sighted but rather top down approach to climate adaptation, while Kochi was just the opposite. Pune, by contrast, was able to walk the fine line between a proactive and progressive city government and an active and mobilized civil society. Industrial voices were however, relatively less visible in Pune's climate action discussion.

3 HOW DOES URBAN FORM INFLUENCE ECONOMIC PERFORMANCE AND CLIMATE SECURITY?

There is by now a vast literature that argues that compact, mixed land-use, short-commute cities supported by transit oriented development and strategic, efficient and affordable public transit are smarter in terms of economic performance, resource use, and energy efficiency.[9] Under what conditions is this true? What is the evidence from the Indian case?

Result 4: Spatial Structure and Pathways to Climate Safety: Are Compact Cities always Climate Resilient? Evidence from Surat and Pune

Surat and Pune are two rapidly growing tier two cities in the country. While Surat, with a population of 4.46 million (Census 2011), is the second largest city in Gujarat after Ahmedabad, Pune, with a population of 3.11 million is the second largest city in Maharashtra after Mumbai. Surat ranks 8th in the country in terms of city population while Pune follows closely behind at number 9 (2011 Census, Provisional). Both cities benefit from a flourishing economic base which. While Surat has evolved from being a key port city to a thriving industrial and retail hub, Pune has evolved from an administrative center, a defense hub, to an education hub, manufacturing and most recently an IT hub. Economic growth has attracted migrants to both cities. Migrants make up over 55 percent of Surat's population and about 30 percent in the case of Pune. However, the urban form of the two cities is dramatically different. Surat's has a compact urban form, with much of it concentrated in the urban core and along major corridors. Pune is less dense with a larger urban footprint. Surat's total urban agglomeration has a population of 4.59 million, of which 96 percent lives within city boundaries. In the case of Pune, the urban agglomeration has a total population of 5.01 million, of which only 62 percent, or 3.11 million is within city boundaries. Between 2001 and 2011 Surat's core has gotten denser, while most of Pune's growth has been on the periphery.

Surat is a classic mixed-use compact city, while Pune has a sprawling, polycentric form. The difference in urban form of the two cities can be attributed to several factors. Surat has traditionally been a compact city with a high intensity of mixed uses ranging from residential, commercial as well as industrial. Thus people have been able to live, work and shop within a small radius. In Pune, industrial development in the 1960s was planned on the fringe areas outside the then city limits. As industries grew, supporting development, mainly in form of residential areas for workers, started mushrooming around these centers leading to leapfrogging of development into a more polycentric form, where residential communities developed around the places of work. In our research we plan to test the impact of different kinds of urban form and spatial structure on economic growth and climate resiliency through this paired comparison of cities.

Our **interim findings** show that the benefits of mixed use, compact, high FSI, dense cities via a smaller ecological and transportation footprint are not automatic. If supportive policies are not put in place, density can create diseconomies and negative ecological externalities. For example, in Surat, mixed landuse provides benefits in terms of more concentrated infrastructure investments and living and working in close proximity provides convenience to citizens, especially during extreme events. Having industries within the city have also led to strong municipal budgets through the aggressive collection of water and service charges from industrial users. However, the lack of public transit and sufficient green cover has resulted in poor air quality. The illusion of proximity has led to the dominance of private motorized transportation that has aggravated congestion, emissions and energy intensity.

By contrast, Pune has land use patterns that reflect a degree of separation among economic activities and related functions. The city core has industries such as education, health and Information Technology, while manufacturing is in nodes and sister cities around the urban periphery. The development of housing in proximity to economic activities has created polycentricism rather than long-commute sprawl. There, may thus be multiple pathways to a climate safe and resilient urban economy.

Result 5: A City's Climate and Economic Security Cannot be Limited to City Boundaries: Food, Water and Mobility Security Depend Upon Urban, Peri-Urban and Rural Linkages

A city's exposure to climate risks and adaptive capacity do not stop at municipal borders. Developments on the urban periphery and the hinterland make a crucial difference to the city's climate and economic security. Food security, water security and other lifeline infrastructures have spatial footprints that extend far beyond the city's boundaries.

9 Lincoln Land Institute (2010), NRC (2009), "Driving and the built environment: the effects of compact development on motorized travel, energy use, and CO2 emissions," Washington, D.C.: Transportation Research Board, National Academies. 227 p.; Ewing R, Cervero R (2010) Travel and the built environment: a meta-analysis, Journal of the American Planning Association 76: 1–30.

For example, the most salient current threat to Surat city, namely the flooding of the Tapi river, has origins in the Ukai dam catchment area upstream from the city and to the degree and intensity of rainfall in neighboring states. Besides augmenting and re-designing city-specific water and storm water systems, Surat had to develop adaptive measures, such as the End to End Early Warning system (EEEWS) that relies on daily, real time connections between the city and monitors stationed at the Ukai dam far beyond the borders of Surat City. Redundancy, overlap, and inter-institutional, inter-state coordination were crucial to build information systems that have since their launch played a key role in averting disasters within the city. The case of the 2013 floods in Surat illustrate this point. The EEEWS was critical to providing the city with the window to respond locally in ways that prevented widespread intra-city flooding.

In our interviews we also found that during the devastating floods of 2006, when 75 percent of the city was underwater for three days, it was farmers from the rural hinterland that were able to enter the flooded city on wide-surface area vehicles such as tractors to bring food, freshwater and first aid kits to marooned city residents. Thus, urban adaptation mechanisms, in order to be effective, need to extend beyond the city limits to other nested spatial, administrative and institutional scales.

4 INDUSTRIAL ADAPTATION: SOME COSTS, BENEFITS AND CO-BENEFITS OF URBAN ADAPTATION

The production structure and the nature of the industrial base is quite different in our four case study cities—Surat, Pune, Ludhiana and Kochi. Surat's economy is dominated by textile processing ad textile trade, zari making and the diamond cutting industry (with petrochemical, steel and gas industries in Hazira). Ludhiana is dominated by small-scale hosiery and light manufacturing firms, Kochi has coir, spices, rubber, sea-food processing units and oil and gas and shipping industries in or near the city. In Pune, capital intensive manufacturing, automotive, defense, health, education and the IT sectors dominate.

How do firms and supply chains of various kinds respond to climate change?

Result 6: Industrial Structure and Industrial Risks: When do firms act?

Broadly defined, we find that just as the nature of climate threats affecting the four cities is different, their response to climate change and adaptation is also quite varied. Given frequent floods in Surat, most industries, including small and medium industries have taken measures to counter such incidents. Some of these measures include, relocating the more expensive machinery, equipment and operations that make or break quality, on upper floors of their factor building. Some of the larger diamond firms have shifted their premises from low lying areas to higher areas, often displacing textile units that have shifted to industrial estates on the urban periphery. In the case of Pune, since most of the large industries are not in the city and the climate has changed very gradually, the awareness of climate related impact is low.

Some of the larger industrial houses like Zensar have begun to adopt some adaptive measures focused on lowering energy use and cutting down emissions, such as restricting the use of elevators and encouraging bicycling to and from work. However, most firms, especially small and medium firms have not undertaken any adaptive measures. The rise in temperature has led most firms to install air conditioning in their units, which is an energy intensive option, but again this has been a gradual process in places like Pune. Interestingly, in Surat, where the temperatures are rising faster, firms—even smaller ones—are exploring lower cost imports from China or turning to "green" cooling systems. In Kochi, the awareness of climate related impacts are more since the incidents of flooding as well as the sea level rise are more visible compared to the rise in temperature in Pune. However, here too adaptation by the industry has been limited and only a few (mostly large) firms have initiated changes most of which include elevating their structures. One advantage that Kochi has over other cities is that its industries (barring spices) such as coir require submerging in water as part of the processing and hence the rise in the water levels (deceptively) appears to them as less of a problem so far.

While there is growing recognition of the risks to cities from extreme events such as flooding and emissions, much less attention is currently paid to the important issue of industrial disasters such as the threats of chemical spills and run-offs during extreme precipitation events or other weather related risks. Securing a city's productive assets and ensuring that they do not cause contamination during extreme events is critical to preventing large-scale losses from damage to human health and the economy.

Result 7: Rising Temperatures Have a Significant Negative Impact on Worker Productivity

Much of what we know so far about the economic impacts of climate change is based on evidence on from agriculture, human health and natural disasters. Little is understood about how climate impacts industrial productivity, and if it does, through what mechanisms are the effects channeled. A key component of industrial productivity is worker productivity. In a study we are conducting on the effects of temperature on worker productivity we used national level manufacturing data to find that at the plant level, manufacturing output responds negatively to high temperatures. Our interim results show that the magnitude of losses is economically significant and amount to a reduction of about 2 percent of daily output per degree Celsius. The response of output to temperature is non-linear and specifically associated with high temperature days. These results were corroborated with primary plant level field data that we collected from one of our study sites (Surat). We also find that temperature response is greatest in plants where the worker value-added is high. This suggests that integrated assessment models may underestimate the global economic costs of climate change by neglecting to account for reduced worker productivity during high temperature days, which, in turn translates into reduced industrial productivity.

Our ongoing field-based interviews on how firms and their value chains are responding to temperature rise and other climate threats (flooding, sea level rise) also show that higher value industries and higher value added activities within industries and firms are the first to be protected—by private action—from climate risks. This leaves lower value and/or more labor-intensive segments of industries relatively more exposed to the effects of climate change. This suggests that there is a strong case for public action in addressing the vulnerabilities of those at the bottom of the labor market and in low value segments of supply chains. The market will not automatically address the risks they face.

Result 8: Climate Adaptation and Public Health Co-Benefits

Climate change induced probable increases in temperatures and rainfall are likely to have public health consequences, notably by increasing the disease window in several Indian cities. We attempted to model the costs of a rising burden of disease and the benefits of successful adaptation using the case of Surat. We picked Surat specifically because of the many proactive measures taken by the city to help reduce the incidence of vector borne diseases in the city through a real-time monitoring system that includes SMS reporting strategies for disease outbreak incidences and follow up action. As a result of these efforts Surat has succeeded in significantly reducing the incidence of vector borne diseases. We focused specifically on malaria, a common vector borne disease in India to explore how shifts in climate parameters are likely to influence the aggregate risk of this disease within the city.

Using past data on cases as well as fitting concentration-response models, we developed a hazard function for malaria within the city using the VECTRI model to predict the new cases of malaria that could possibly emerge in the future. We further made efforts to monetize the health risk with respect to morbidity within city boundaries and the costs of treatment. This helped establish the burden of malaria likely to be faced by the city from an economic point of view in the BAU scenario, i.e., the costs of doing nothing. Against these costs we estimated the expenditures undertaken by the government to put in place adaptation measures, specifically, a public health program that distributes treated bednets to households and provides other preventive and curative interventions. These expenditures were taken as a proxy for assessing adaptation requirements against the projected malarial risk.

Our interim findings show that Surat faces an increased risk of disease in the facing of rising temperatures and humidity. There are likely to be more months with higher transmission widows (based on projections with a control period of 2001-2010) with cases being reported in winter as well as the traditional peak transmission months of September and October. Comparing the costs and benefits of adaptation we find that against launching a public health program that costs the municipality approximately Rs. 40 lakhs (based on interviews with the Deputy Commissioner (Health) and publications shared with us), which includes prevention costs of Rs. 6 per treated bednet and Rs. 16 per repellent kit, the city avoids on average Rs. 200-250 per person in treatment costs and between Rs. 1300-Rs. 2100 in wage losses per person. The benefits of adaptation or the per person costs saved, when aggregated across the exposed population city-wide outweighs the cost of adaptation (the specific program in this case). Even if only 1700-2600 people out of a city of 4.46 million are actively exposed to the disease in a given year, the program would recover its costs.[10]

10 Surat has gone beyond these programs to set up an Urban Health Center in collaboration with ACCCRN funding, which would reinforce the efficacy of current programs.

POLICY BRIEF OVERVIEW

Asian Cities Climate Change Resilience Network (ACCCRN) is a network of cities in India, Indonesia, Thailand, Philippines, Bangladesh and Vietnam, experimenting with a range of activities that will collectively improve the ability of the cities to withstand, to prepare for, and to recover from the projected impacts of climate change. One of the key intervention focuses to build policy debate around UCCR. Policy makers seek evidence-based guidance as a foundation for decision-making. ACCCRN India partners have been working with cities in India since 2008 and it highlights sound practices, demonstration projects and interventions on building resilience to climate change.

It was recognized to tap the knowledge and develop evidence-based Policy Briefs to address the needs of the decision makers at the level of the national/state and city government on UCCR. In the period 2013-2014, ACCCRN India is producing a series of UCCR policy guidance briefs. For a complete list of reports, case studies, policy briefs, please visit www.acccrn.org.

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University of Cape-Town Climate Information Portal (2046-2065) and MoEF's PRECIS model for the 2030 projections.

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