

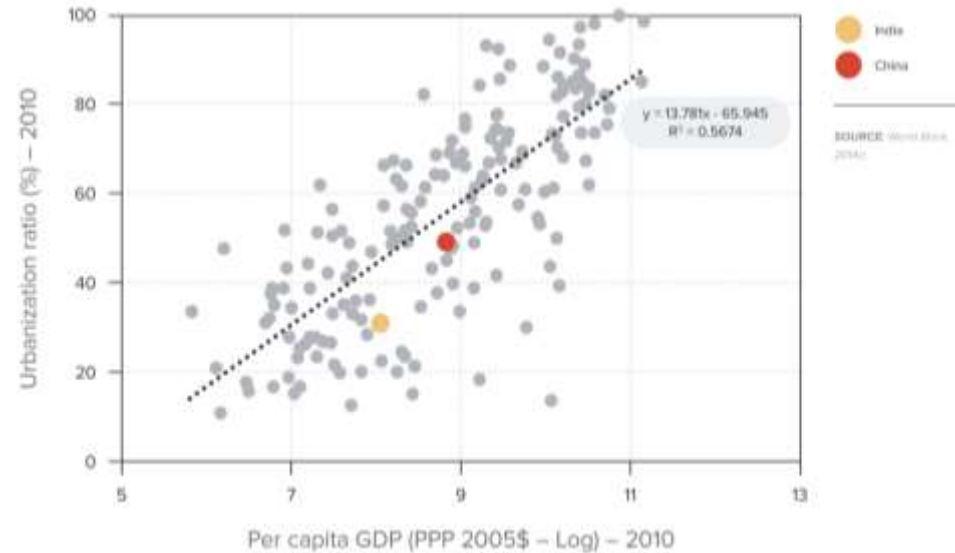
Resiliency Urbanism

Economic Resilience in a Changing Climate

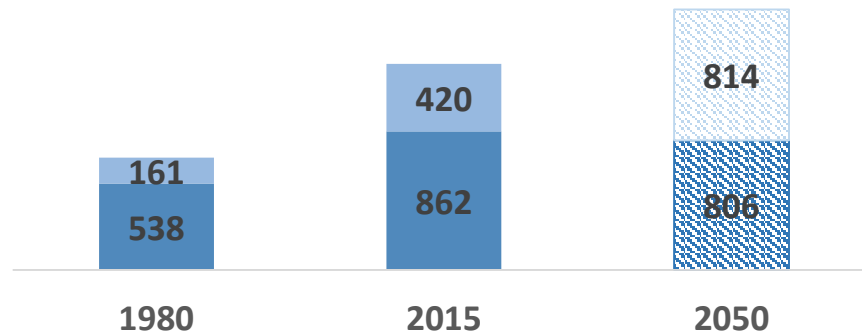
Tales of Adaptation from Four Indian Cities

Meenu Tewari
mtewari@unc.edu

Massive urban transition at a time of climate change



India's urban population is expected to double by mid-century



Source: World Urbanization Prospectus



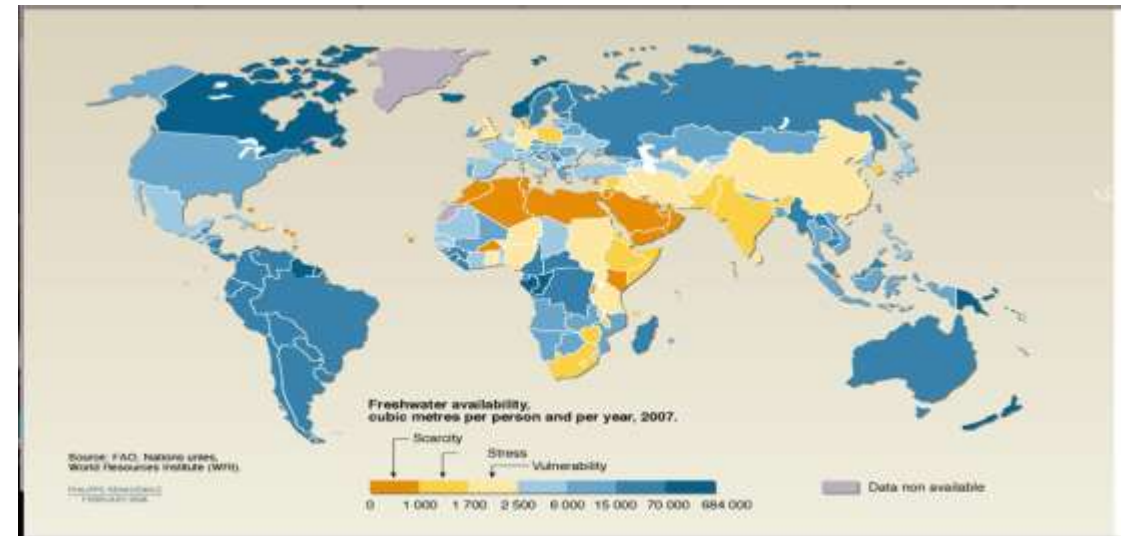
FIGURE 4: India's growing Ecological debt (1961 – 2003)

- Cities are the engines of economic growth, but also at the greatest risk from a changing climate, given the concentration of human life and resources.

Resources are under stress, especially water

A fifth of the world's population with access
To only 3% of the world's fresh water resources

Dwindling, weak storage; Depleting ground water



- Adaptation will be critical....and the time to act is now

Adaptation is a spatially rooted, highly variable process

- ❑ How is this local process playing out in Indian cities.
- ❑ What motivates resource constrained cities burdened with huge development deficits and weak planning institutions to act on perceived climate risks.
- ❑ How can adapting to the risks of climate change actually enhance the competitiveness of cities?
 - ❑ Under what conditions can economic development and climate adaptation go hand in hand, reinforcing each other, rather than be inevitable trade-offs.

Chose 4 secondary cities for a deep dive

4 Study Cities

Mixed methods – Case studies, field research
Data analysis

Choice of cities -- 4 Rapidly growing secondary cities;
Where ACCCRN or partner agencies had worked before.

Laissez faire, entrepreneurial

Ludhiana
3,487,882

Benign top-down technocracy;
Involved business elite

Surat
4,585,367

Competent and effective;
Strong & vocal civic society

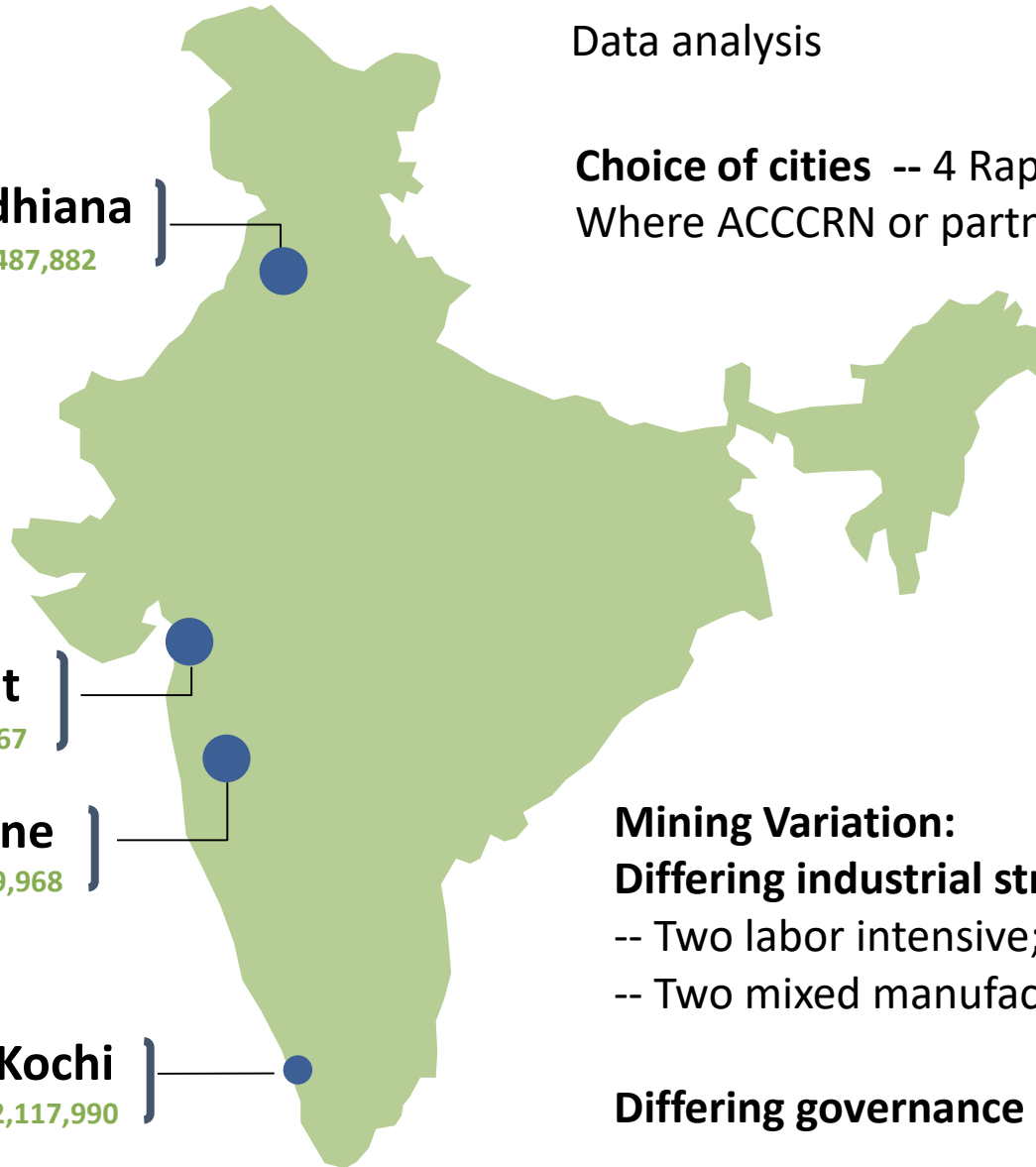
Pune
5,049,968

Participatory, rule-bound;
Active advocacy groups

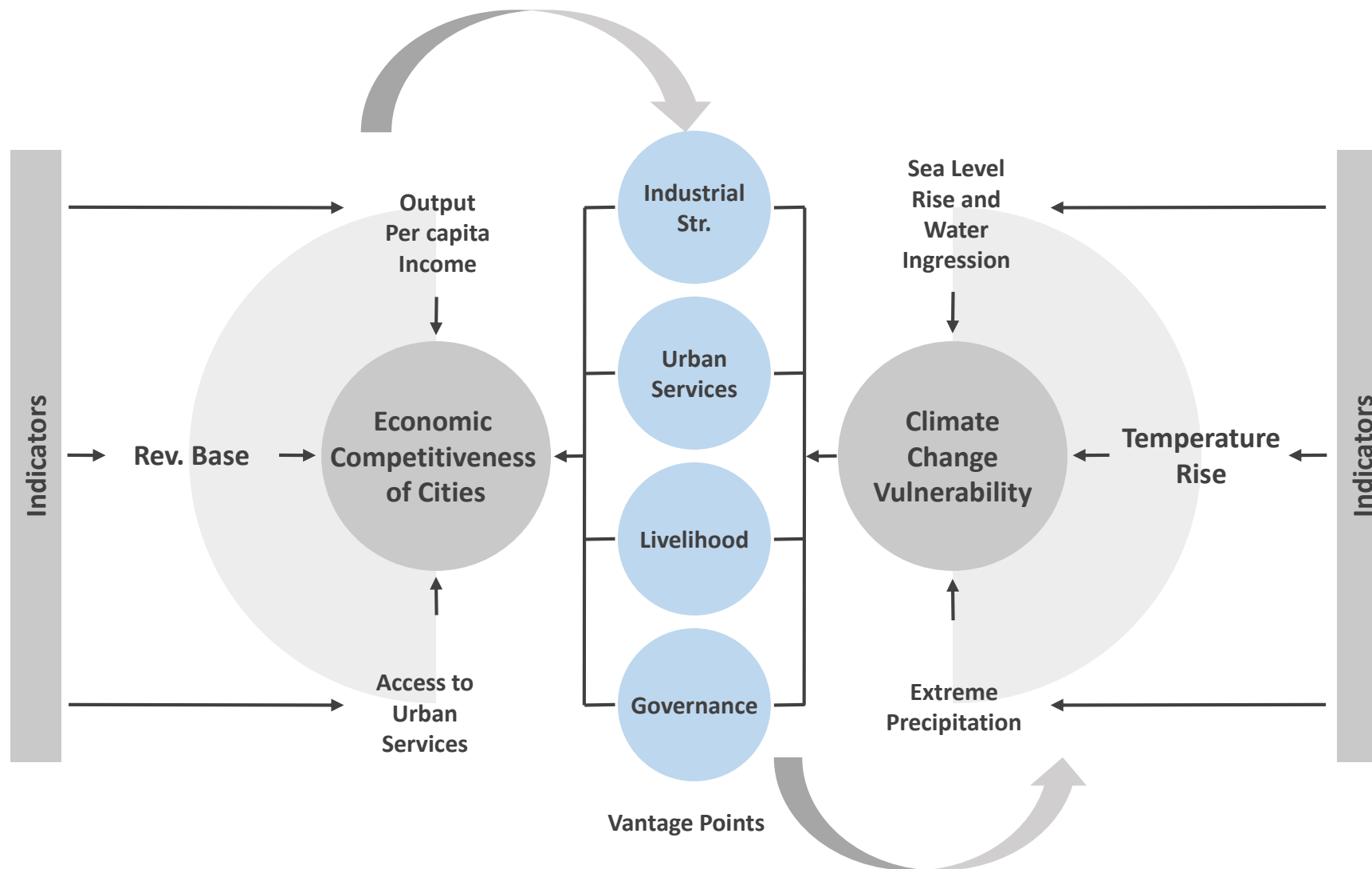
Kochi
2,117,990

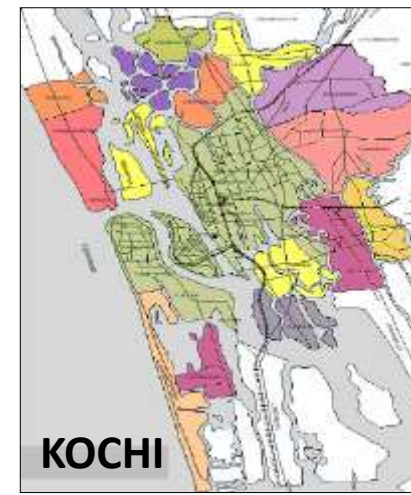
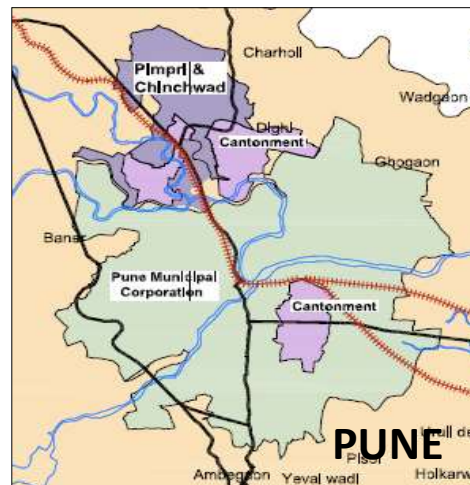
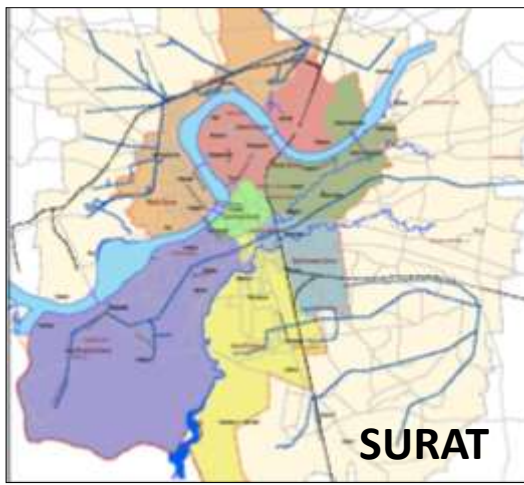
Mining Variation:
Differing industrial structures
-- Two labor intensive;
-- Two mixed manufacturing and services led

Differing governance structures



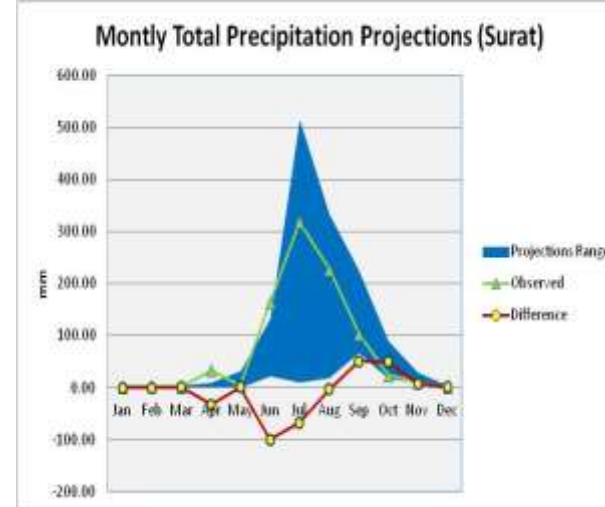
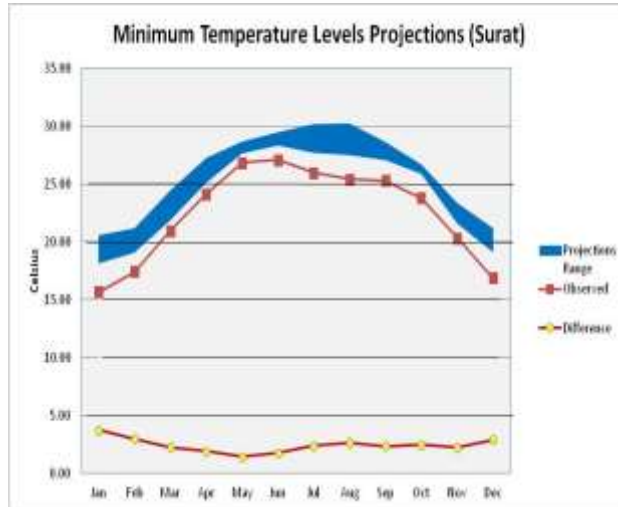
Study Approach





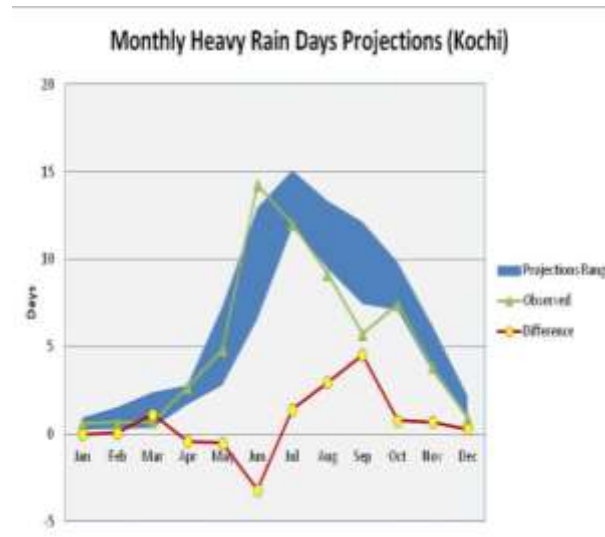
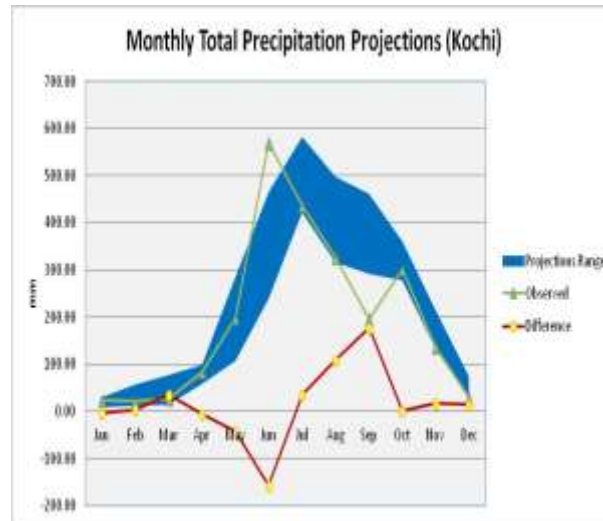
Population (UA):	4.58 million (97% is city)	5.05 million (62% is city)	2.2 million (28% is city)
Area (City)	326.24 sq kms	243.84 sq kms	94.90 sq kms
Density (City)	13,670.92	12,754.27	6,322.44
Growth '91-'01	85.1%	50.6%	18.8%
Growth '01-'11	63.09%	34.28%	56.20%
Spatial Growth	dense part – central zone -getting denser	Both city core and the suburbs are growing	suburbs (west, north and north east) growing faster than the core
Ann. hhld income	Rs. 457,000		
Literacy	89.03%	97.49%	91.61%
Gender Ratio	758	945	1028
Unemployment Rate	0.65%	27%	3.5%
Poverty Rate (BPL)	10%	Almost 50%	35%
% of City Population in Slums	17%	40%	18.9%

Surat



- Higher winter minimum
- Disease window increases
- Reduction in Precipitation-water storage implication

Kochi

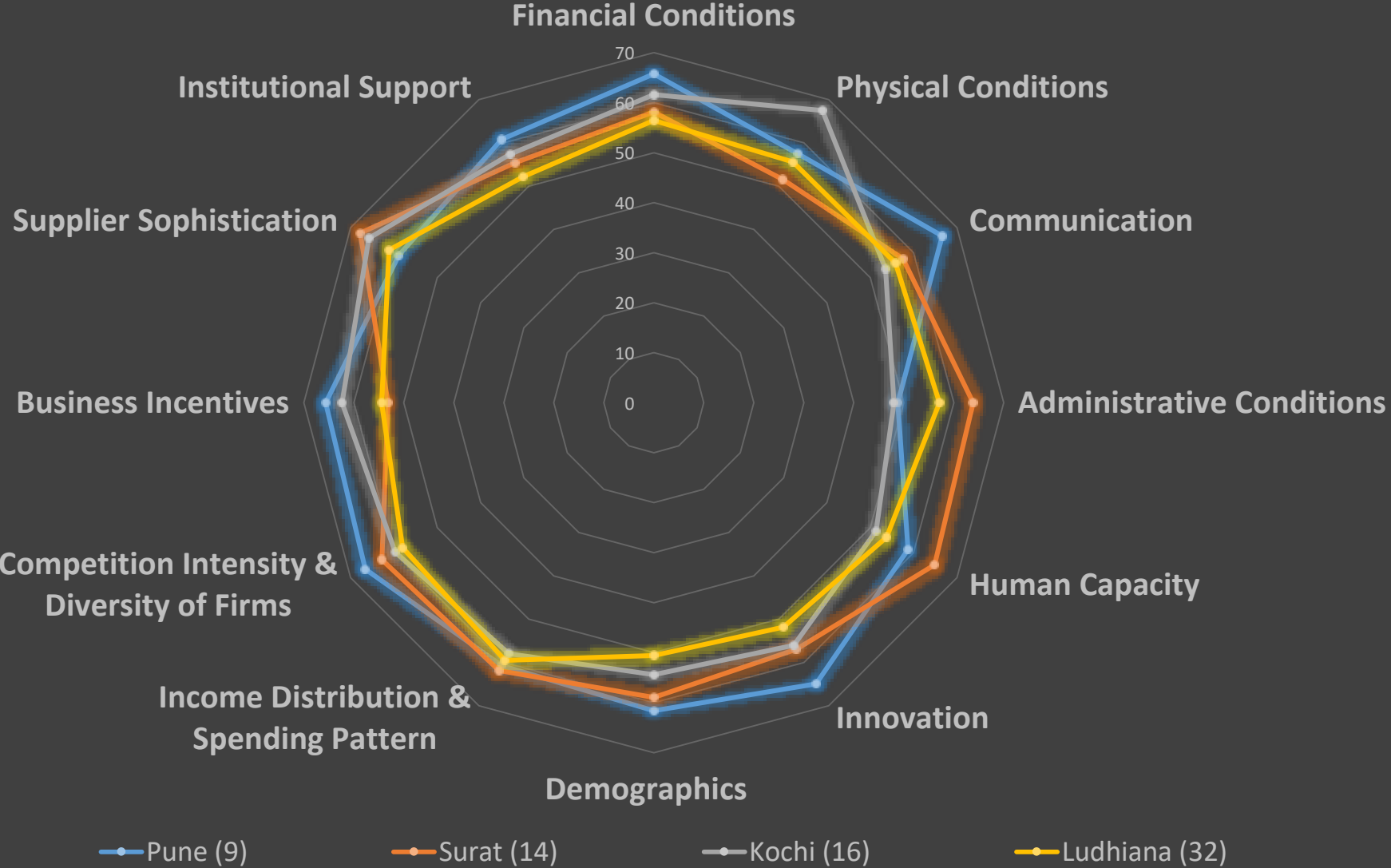


- Sharp rise in total rainfall-unexpected patterns
- Overall increase in heavy rain days (serious storm water drainage issues)
- Fisheries impact
- Hydropower Impacts

City Vulnerability Profiles

City	Population	City Growth (%)	Key Climate Concern
Surat	4,585,367	83.3	Flood risk, sea level rise Secondary risks surges, salt water inundation of the Tapi estuary, heat and humidity
Kochi	2,117,990	0.9	Sea level rise, intensity of monsoons, saline inundation, threat to water systems (availability, collapse of drainage)
Pune	5,049,968	22.7	Periodic flash floods, water availability
Gorakhpur	671,048	7.8	Riverine flooding

Mapping Economic Competitiveness



Who is likely to act on climate adaptation and under what conditions?

Q1

Finding 1: When perceived risks are diffuse, uncertain, non-specific or seen as not affecting those that hold social or economic power, motivating climate action by local governments is difficult – unless the problem crosses a threshold, or there are external nudges.

- Ground water depletion in urban peripheries, unsafe effluent discharge in labor-intensive industrial cities (Ludhiana, Surat), poor solid waste management

Finding 2: Uncertainty in climate science and downscaling to city scales can be a source of resistance to climate action

- Clarity on how climate impacts impinge on cities is lacking
- City specific climate models needed
- Downscaling of results from models at the national level is rare
- In the face of multiple other demands, climate threats are therefore seen as distant, vague and costly – a strain on already limited resources – not an immediate priority

Policy takeaways

- *Gathering better data is key.*
- *Can the regular collection of economic and climate relevant data at the city level be made mandatory?*
 - *Example: National programs such as JNNURM and AMRUT, SMART tried to do this – or had this effect.*
- *Create city level climate cells with funding, training, and a seat at the table.*
- *Support cities in fostering City-University-Community linkages backed by meaningful incentives.*

Finding 3: Differences in climate consciousness between gradual and sudden onset impacts can shape adaptive responses in deep ways

- **Gradual onset events** – such as temperature rise, air quality, pollution, ground water depletion, sea level rise are **notoriously difficult to act on** as opposed to extreme precipitation events, floods, or disease contagion
- **Gradual onset of climate impacts can lead to costly lock-ins when policy makers are confronted with an escalation of a known hazard.** --- This can lead to a much more costly adaptation process for the city after the fact.
 - E.g. the gradual submergence of low-lying areas on Mattancherry is not new; but the recent worsening of the situation by increasing incidence of rainfall has caught the government and residents off-guard.
- Cities with experience of repeated sudden onset climate related extreme events **may** be more amenable to climate action (e.g. Surat)
- But even so, if the event is perceived as being a natural hazard, the response can stay **limited to disaster-management-orientation**, and the urgency to transform can be lost with time (e.g., recent Kochi floods)

Policy Takeaways

- A short term focus and poor planning can *lock in* urban assets leading to many investments being *stranded* and others being *stretched beyond their capacity*.
- Climate aware, strategic planning can pay *economic dividends today* and *lower the cost of adjustment over time*.
- “*Strategic planning devices*” that Salet (2007) and others talk about might be needed *to align goals, create a vision and build political coalitions*. But this first requires city officials or other leaders to be convinced of the cause.
- *Unbundling and leveraging existing complementarities* between provision of urban services and climate resilience can lower costs and generate co-benefits
- Careful balance between strong administrative wing at the city level, political support, and meaningful participation, can help foster *linkages between different scales of government, politics and society*

Finding 4: One acts when something of deep value is impacted.

We found that cities act in climate adaptive ways (even if they don't call it that or think of it in those terms) when:

- (i) the bottom line of the business elite is badly impacted (Surat).
- (ii) When the bureaucracies' own self image of competence is called into question or is at stake on a public stage (Surat in wake of the 1994 Plague).
- (iii) When concentrated risks are faced by a politically strong and vocal group (Surat industry that relied on global diamond supply and demand).
- (iv) When strong advocacy groups or civic groups are active and organized (Pune, Kerala).
- (v) When external nudges arrive from higher level governments or non-state external actors via funding and technical assistance

Illustration: **The Surat Story**

The floods and plague contagion of 1994 is generally regarded as an important turning point for Surat economic and climate performance.

- In a striking pivot around those events of 1994, **the city went from being the dirtiest in the country to the cleanest by 1995/6.**
- The **same mediocre, ineffective bureaucracy** turned around into more of the more efficient **and capable** local governments in the country.
- Strikingly, **these changes have not faded with the passing of time**, but have stayed for over 25 years – a remarkable feat in itself.

But Surat has had floods for a 100 years. Monsoon related disease and mortality is endemic. Nothing changed before.

So what was different about 1994?

- (i) The nature of the disease – not isolated to poor quarters, but could potentially involve all
- (ii) A dent in the business reputation of the industrial elite – migrant workers fled, buyers hesitated to come in
- (iii) A public shaming of the local bureaucracy on a global scale – a calling into question of their competence.
- (iv) Could not label the twin events as “natural disaster” alone. It was human-made and avoidable; just like the 2006 floods would be for different reasons
- (v) With powerful political, economic and self-interests aligned, the city acted – in the public eye.

It is interesting to reflect on the sequence of SMC's actions

To control a flood related disease contagion, they

1. acted on solid waste, garbage, sewerage and drainage first. Not on water.

2. Their initial spatial focus was the city's slums, the poorest neighborhoods.

- Cleaned out the garbage, set up solid waste collection mechanisms, paved the road with Kota stone
- Desilted the drains and fixed sewerage lines.

3. Organizational reforms came next. **Street level bureaucrats** and their two-way interaction with middle managers lay at the core of the new accountability mechanism that were set up – linking multiple levels

4. Then redoubled focus on securing the water system, focusing on:

- water source reforms
- quality
- distribution
- costs
- public health

Building up your own high water marks by acting and learning

They muddled through. No magic bullet

Still, by acting, learning occurred and capacity got built.

As you act you learn and create your own high water marks, build capacity to do more. It is messy and often an act of muddling through.

- The results brought public appreciation, and trust.
- This helped build support (and demand) for sustaining such action.
- Good performance also had financial consequences – Surat was able to increase fees and property tax rates, with local support.
- Good performance and adaptive outcomes can signal growing institutional capacity (awards were won), which can draw the attention of higher levels of government – and later ACCCRN-TARU– which in turn brought resources and new knowledge.
- Program support from higher levels of government (JNNURM, Biogas initiative, Solar City) and ACCCRN, in turn led to greater institutional clarity and institution building (NRW cell, EEEWS, SCC Trust, and many more.

At the same time this built public responsiveness from below

- When the city successfully aggregated demand for Round II for Rooftop solar
- It reached out via the press, and other ways to explain the services and benefits
- Got a huge response from RWAs and others that came forward to participate.
- **Without bottom up support efficient top-down solutions are hard to sustain.**
- That support comes about of credible performance, trust and engagement

EVEN so...

....It was the most visible problem that was addressed – flood risk, water, public health, and the nested sectors involved in this.

Similar adaptive concerns did not necessarily spill over into other areas (slow onset) – e.g., air quality, public transit, till much later.

Same with green building now, even though there is great success with rooftop solar.

This suggests that sectoral strategies might have important **latitudes and linkage characteristics** that might be worth exploring as potential entry points for adaptive action

Industrial Structure and Industrial Risks: When do firms act on climate threats?

Finding 5: Rising temperatures have a significant negative Impact on Worker Productivity, and through that mechanism on industry's contribution to GDP

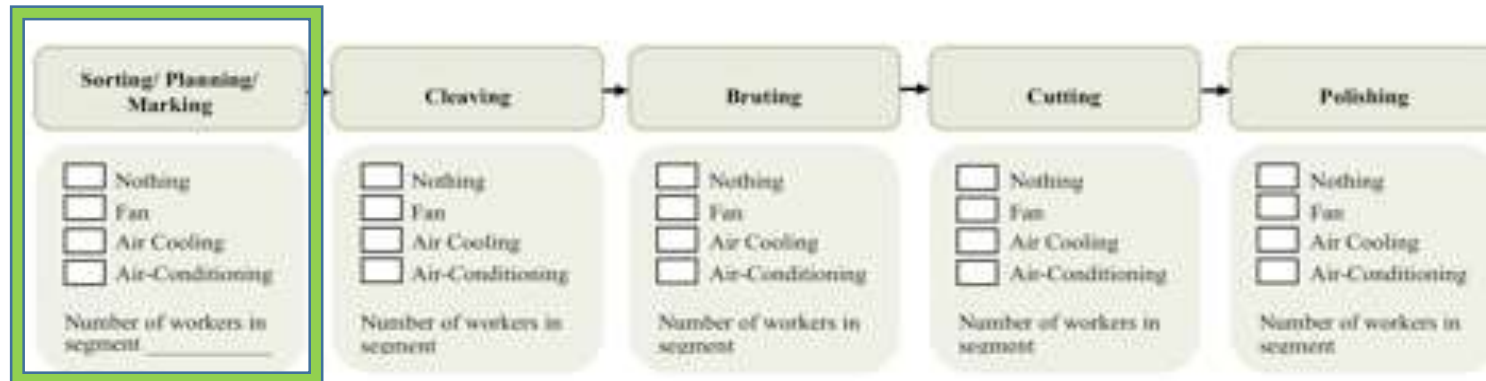
Little is understood of how climate impacts industrial productivity, and if it does, little is known through what mechanisms the effects are channeled.

- Used multiyear panel data of manufacturing plants in India, as well as daily worker productivity data from selected case-study units in Surat and other settings*
- Found that worker productivity declines by as much as 4 to 9 percent per degree rise in temperature on hot days.
- Sustained heat also increases absenteeism.
- Similar temperature induced productivity declines were replicated in annual plant output from a national panel.
- **Our estimates imply that warming between 1971 and 2009 may have decreased manufacturing output in India by at least 3 percent relative to a no-warming counterfactual.**

*with Anant Sudarsha, E. Somanathan and R. Somanathan

Finding 7: If left to the market, firm level adaptation to climate threats is likely to be uneven and selective.

- Firms, like cities, respond selectively to climate risks and primarily when threats impact high value investments and output.



- In both the textile and diamond industries, large and small, we found that the highest value-adding Segments of the internal work-chain was climate controlled; not necessarily those with more workers.

Policy Takeaways

- *If left to the market equitable outcomes may not be automatically forthcoming for dealing with extreme heat or other extreme events.*
 - *The government would need to intervene to ensure the lowest paid workers in the lowest value adding segments of the work chain were also protected.*
- *This also implies that cities need to pay closer attention to the location and design of urban industrial zones.*
 - *Cool roofs, water bodies, green cover, green building technologies, alternative, lower energy systems and alternative systems of lighting and air temperature control as well as other urban planning innovations are needed to lower ambient temperatures and combat urban heat island effects.*
- *There exists an entrepreneurial opportunity for innovations related to finding low carbon and energy intensive solutions to climate control of built spaces.*
 - *currently some of the smaller firms are traveling to china to look for affordable clean/green options.*
- *Finally, one of the most neglected industrial risks relates to industrial disasters (chemical spills etc) during extreme events.*
 - *There are few standards that currently secure these assets in the face of climate threats.*

Finding 6: Climate Adaptation and Public Health Co-Benefits: Negative impact on health and increased risk of disease

- Cities face an increased risk of disease in the face of rising temperature and humidity. 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

Policy Takeaways

- *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*
- *Policy action will be needed to deal with this growing human and economic risk*

How Does Urban Form Influence Climate Security?

Finding 7: Urban form can influence both economic productivity and the cost of a climate security

- A city's spatial structure can shape its economic performance and environmental effectiveness.
- Compact cities are considered low carbon and climate safe.
- However, the benefits of mixed use, compact, high Floor Area Ratio (FAR), 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 overcome diseconomies of urban density and negative ecological externalities.
 - E.g., Surat. Compact, mixed use, but poor air quality because the city put public transit on a back burner
 - A strong and effective modal shift is now happening in Surat as a result of extensive investment in bus services.

Finding 8: A city's climate and economic security cannot be limited to city (municipal) boundaries alone

- Adaptive planning cannot be confined to narrow jurisdictional boundaries.
- Food, water and mobility security depend upon urban, periurban and rural linkages; the political economy of adaptation is a cross-boundary process.
 - Example: Surat's flooding linked to forces outside the city (Ukai dam and the intensity of precipitation in the related catchment area); but support also came from farmers outside city borders. Same with fishermen during the Kerala floods.
 - The most effective response to flood management in Surat was also inter-jurisdictional and collaborative -- the End-to-End Early Warning System (EEEWS) which linked Surat municipality with the Ukai Dam management.
 - Case in point: the successful containment of the 2013 floods.
- Our analysis of city development plans and a variety of other planning documents showed that barring Kochi (2 municipalities 13 gram panchayats), all other 3 cities have plans focusing on the city alone.

Policy Takeaways

- *Regional scales allow for the combination and recombination of multiple spatial scales that is key to adaptive planning.*
- *Redundancy, overlap and inter-institutional, inter-state linkages are crucial to building the trust and the knowledge systems that will help foster effective responses to achieving climate security.*

Exclusions and Inclusions

Finding 9: A city's economy is as climate secure as the weakest link in its chain

Example: Surat. A fairly technocratic city government was compelled to *first focus on the slums*, secure the poor neighborhoods to deal with the disease catastrophe it faced in 1994.

It cleaned out the garbage, managed solid waste, paved the roads with kota stones, fixed the drains and connected them to sewer lines.

This continued in the mid 2000s when it began moving them from low-lying unsafe areas.

But when risks can be quarantined, then where is the motivation to be inclusive?

Migrant labor most vulnerable to climate impacts, especially new migrants

- Surat & Kochi both have high levels of migration and share of migrant labor
 - Surat – majority single men living in overcrowded quarters in most vulnerable parts of the city (next to khadis) with minimum income buffer to safeguard from climate setbacks.
 - Weak access to services – housing, transport, health - especially new migrants
- This had wider repercussions for the urban economy

In Surat, the setbacks to the city's economy from flooding were two-fold:

Direct impacts due to inundation of establishments (homes, businesses, factories, etc.) and

indirect impacts resulting from interruption of supply chains for both goods and labour because of flooding of transportation hubs and networks.

- **By securing its most vulnerable groups, a city can secure its wider economy**

Finding 10: Bringing Equity Back in

- At the end the biggest surprise was when our quantitative work resonated with what our case study and qualitative work in Surat, Kochi and Pune had already suggested:
- that a set of social factors associated with equity, inclusion, and literacy were associated with a city's adaptive capacity as well as its relative competitiveness.

Using a two-step PCA analysis for 10 cities and then a correlation matrix for our 4 cities, five variables were identified as most significant (having the highest weights) for both economic competitiveness and climate resiliency.

These were:

1. Proportion of the population living in slums (.10)
2. Proportion of waste water treated (.10)
3. Availability of public transportation (.10)
4. Literacy levels (.09)
5. Employment shares (.08)

These indicators carried higher weights for being associated with both climate resiliency and economic competitiveness than variables such as per capita investment on assets (.07), area under green cover (.07), water supply cost recovery (.07), average trip length (.05), per capita income (.05), government revenue expenditures (.05), among others.

Making the city a place of flourishing for all

- It is striking that variables connected to equity/welfare/inclusion/education and responsible use of resources (waste water treatment, public transit) are associated with a city's climate resilience as well as economic competitiveness.
- This important finding reinforces our qualitative results that show that in the medium to long term **a city's resiliency and adaptiveness – both economic and climate related -- is limited by the extent of its inequities and urban disparities, and the fortune of its most vulnerable.**
- Making progress on improving equity can help improve its economic drivers and climate resilience.

Conclusion - Resiliency Urbanism?

An urbanism that speaks not of bouncing back to the status quo after disruptions – economic or climate related

But one that is transformative

Bouncing back, to do things differently each time,

- Reducing its use of resources each time, in all activities
- Reusing,
- Recycling,
- Renewing,
- Innovating,
- Being inclusive and Equitable
- Muddling through messy and incompletely understood experimentation – *deliberatively, reflectively*.

Making cities places of human flourishing for all.