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The Governance of Climate Change Adaptation through Urban Policy Experiments

Abstract: Climate change is increasingly posing risks to infrastructure and public services in cities across the global South. Building on ideas of policy experiments at the nexus of institutional and transition theories, this paper assesses six climate change adaptation experiments across the cities of Surat, Indore, and Bhubaneswar in India to uncover the politics behind how experiments are conceived of, implemented, and supported in light of local development needs. Through employing both embedded and cross-case comparative methods, I argue that policy experiments are often framed around achieving tangible urban economic benefits and maximizing specific project complementarities, which allow emerging adaptation priorities access to established policy directives and funding streams. However, I conclude that despite being arenas for testing new ideas, quantifying climate and development co-benefits, and engaging private and civil society actors, adaptation policy experiments must be coherent with urban political economic contexts in order for them to affect sustained, equitable, and transformative programmatic change.

Keywords: Climate change adaptation; urban governance; policy experiments; urban planning; India

1. Introduction

Cities across the global South are realizing that adaptation to projected climate impacts cannot be addressed independent of urban economic development processes and livelihood security priorities (Brooks, Grist, & Brown, 2009; Wamsler, Brink, & Rivera, 2013). The literature has moved away from treating climate change solely as an environmental problem, but instead as a series of systemic pressures on urban public institutions, industries and firms, and social network (Anguelovski, Chu, & Carmin, 2014; Hunt & Watkiss, 2011). In this vein, there has been a corresponding increase in empirical assessments of the interconnections between adaptation, governance, and development, as well as research on tradeoffs between different policymaking pathways and approaches.

Building on ideas of urban governance, climate adaptation, and policy experiments articulated within the broad fields of institutional change and urban transitions, this paper critically assesses how three cities in India have framed and implemented adaptation priorities in light of economic development needs. I ask the following question: how are urban climate adaptation policy experiments initially framed and eventually adopted and implemented in India?

To answer this, I begin with a discussion of theories of adaptation and development in the context of urban institutional change, transition, and rapid urbanization. Then, using an embedded case study method, I present six climate adaptation policy experiments in the Indian cities of Bhubaneswar, Indore, and Surat to highlight how these experiments were initially conceived of, how they were incentivized and adopted, and the implications of each in facilitating development. In the second portion of the paper, I switch to a cross-case comparative method to unpack wider trends of policy experimentation. I first observe that in order to gain awareness, adaptation experiments need to be framed around tangible economic development needs with visible near-term benefits. Second, in order to achieve synergistic experiments, there exists an interactive process of uncovering and framing co-benefits between adaptation and development priorities. Finally, even though experiments are critical for testing ideas, harnessing innovation, and quantifying co-benefits, I argue that they must be coherent with urban political economic contexts in order for them to affect sustained policy and programmatic change.

2. Theories of experimentation in urban climate adaptation

Climate change adaptation is the process of adjusting to actual or expected climate risks and impacts (IPCC, 2014). Urban development – referring to processes that protect local livelihoods, promote economic growth, and improve infrastructure and services – can be affected by climate change (Adger, Huq, Brown, Conway, & Hulme, 2003). Climate risks can also exacerbate poverty (Ayers & Dodman, 2010), so improving the adaptive capacity of communities may help improve local livelihoods and facilitate sustainable development (Boyd, Grist, Juhola, & Nelson, 2009; Brooks et al., 2009; Carmin et al., 2015). Many cities oversee responsibility for managing infrastructure and social services that are essential for good living standards, inclusiveness, and the reduction of climate vulnerability (Anguelovski & Carmin, 2011; Dodman & Satterthwaite, 2009). Still, cities in global South – in particular – have historically had to operate within strict resource limitations that constrain their capacity to plan for and operationalize particular adaptation strategies (Anguelovski et al., 2014).

To bridge capacity and financial deficits, many cities have elected to pursue an experimental approach to climate adaptation planning and policymaking (Bulkeley, Castán Broto, & Edwards, 2015; Carmin, Anguelovski, & Roberts, 2012). In general, experiments seek to transform entrenched government practices and generate new governance capacities (Healey, 2004). In this paper, I build on two strands of theory on governance experimentation and innovation: theories on institutional change and theories on urban transitions. The former interrogates pathways of learning, networks of actor interactions, and opportunities for transforming the structure of decision-making systems (Argyris & Schön, 1978; Healey, 2006; Rondinelli, 1983). The latter engages theories of technological change and identifies particular niches of expertise and creativity as sites for testing innovative practices (Geels & Schot, 2007; Geels, 2002; Smith, Stirling, & Berkhout, 2005). Both theories speak to different approaches to learning, replicating, and embedding experiments in large policy structures, but neither speaks directly to how the nature of experimentation changes across political economic contexts.

For many cities, experimentation as a governance and policy approach is attractive because it promotes innovation through improving overall decision-making efficiency, effectiveness, and

responsiveness (Moore & Hartley, 2008). Methodologically, experiments are able to support evidence-based policymaking by giving robust and timely advice for evaluating and redesigning existing approaches (Stoker & John, 2009). In this sense, experiments can be seen as “laboratories” of learning and best practices (Karvonen & van Heur, 2014; Nevens, Frantzeskaki, Gorissen, & Loorbach, 2013), which allow diverse actors, networks, and policy pathways to embed emerging needs and priorities into urban policies and plans (Evans, 2011). For cities in the global South, such experiments are often supported by transnational actors or organizations who are able to provide necessary funds, skills, knowledge, and networking capacities (Bulkeley et al., 2012)

When applied to climate adaptation, experiments allow stakeholders to flexibly frame (and reframe) objectives, implement trials and pilot projects, and monitor and evaluate project outcomes (Cárdenas, 2009). They also allow local governments and civil society actors to test implementation pathways, help prioritize climate adaptation options, and evaluate overall project benefits in the face of uncertain climate futures and highly decentralized (or fragmented) governance arrangements (Anguelovski et al., 2014). Although some have challenged the external validity and replicability of experiments, this methodology has been shown to be a good arena for intensive dialogues and small-scale innovations (Stoker & John, 2009). The interactive quality of many experiments facilitates deliberation processes (Fischer, 2006; Forester, 1999; Hajer & Wagenaar, 2003) that may improve the social inclusiveness of policy outcomes or solve intractable conflicts (Feola & Nunes, 2014; González & Healey, 2005; Schön & Rein, 1994).

Despite the many opportunities of policy experimentation, theories on institutional change and urban transitions are less clear about their prospects in governance contexts characterized by low levels of resource support, scientific uncertainty, highly contentious policy priorities, and uncertain networks of stakeholder engagement. Until recently, scholarship on climate adaptation in Southern cities have focused on uncovering co-benefits with existing urban development, poverty reduction, and disaster reduction agendas (Puppim de Oliveira, 2013). Though these recent advancements are important, there remain questions around how such co-beneficial outcomes can be pursued in highly uncertain political economic arenas and where the effectiveness of such strategies is often also dependent on local participation. Stakeholder engagement in the design, implementation, and

monitoring of adaptation interventions is important because the implications of climate risks and impacts are ultimately interwoven with specific populations and regional vulnerabilities (Archer et al., 2014; Chu, Anguelovski, & Carmin, 2015; Nay, Abkowitz, Chu, Gallagher, & Wright, 2014).

The purpose of this paper, therefore, is to uncover how theories and approaches to policy experimentation – as elaborated in theories on institutional change and urban transitions – can be empiricized and applied to rapidly urbanizing contexts in the global South. Under these scenarios, emerging climate adaptation priorities must contend with powerful political forces advocating for particular development needs, as well as share the governance space with entrenched private sector or civil society interests. In other words, this paper advances theories of policy change and innovation by highlighting the implications of experimentation in uncertain, contentious, and fragmented governance landscapes that characterize many cities in the global South.

3. Methodology

This paper uses embedded and cross-case comparative case study methods to critically assess six climate adaptation policy experiments in the Indian cities of Bhubaneswar, Indore, and Surat that seek to balance urban economic development, local livelihoods, and adaptation priorities. These three cities (see Table 1 for details) were selected because they have long histories of engagement with key international programs, including the Rockefeller Foundation’s Asian Cities Climate Change Resilience Network (ACCCRN)¹ and the Climate Risk Management project sponsored by the United Nations Development Programme (UNDP). Furthermore, these cities have successfully advocated for their own development needs while working within transnational networks.

[TABLE 1 HERE]

The empirical analysis is based on fieldwork conducted in Bhubaneswar, Indore, and Surat between January 2011 and June 2014. The data draws on semi-structured interviews with stakeholders involved in each of the city’s adaptation planning process, observations of planning meetings, and an

analysis of municipal plans and reports. I conducted a total of 25 interviews (see Appendix for details), which relied on snowball sampling to identify adaptation experts in the different municipal governments, development authorities, and private and civil society sectors. The interviews were recorded, transcribed, and coded thematically to understand how cities framed and implemented experiments that promoted both adaptation and development. The combination of embedded and cross-case comparative methods allows for a critical assessment of major political and institutional trends found across the three cities. The data is further supported by select quotes and illustrated synthetically in Tables 2 and 3.

[TABLE 2 HERE]

4. Embedded case studies of adaptation experiments

Cities in India are projected to experience rising surface temperatures, changing monsoon seasons, and rising sea levels, which result in loss of livelihoods, social safety nets, and capacities to cope with impacts in poor communities (Revi, 2008; Sharma & Tomar, 2010). In 2008, the Prime Minister of India approved the *National Action Plan on Climate Change* (Atteridge, Shrivastava, Pahuja, & Upadhyay, 2012; Vihma, 2011). The regulatory and knowledge infrastructure for climate change is decentralized across national, state, and local authorities, and is based on the idea that planning for climate change requires actions that are transparent, accountable, and cognizant of local contexts (Fisher, 2012; Sharma & Tomar, 2010). The embedded case studies described in this section are framed around three narratives: (1) community-based hazard response in Bhubaneswar, (2) water infrastructure upgrading in Indore, and (3) urban health capacity-building in Surat. Since 2009, these three cities have tackled emerging climate priorities through policy experiments that combine adaptation and development (Chu, 2015; Karanth & Archer, 2014).

4.1. Hazard preparedness and response in Bhubaneswar

Bhubaneswar is situated on the Mahanadi Delta in the eastern coastal plains of Odisha and is managed by the Bhubaneswar Municipal Corporation. The city has a population of nearly one million and has 377 slums, which account for approximately 50% of the population. Bhubaneswar has experienced many major climatic events in the past, including heat waves, cyclones, and floods (Chittibabu et al., 2004). A particularly serious heat wave occurred in 1998, which led to more than 120 deaths. In 1999, Bhubaneswar experienced a super cyclone with winds of nearly 300 kilometers an hour (Thomalla & Schmuck, 2004). During this event, many buildings were damaged and basic services like water supply, sewage drainage, solid waste management, food supply, and communication came to a halt (Interview 2013). The cyclone cause more than 10,000 deaths across Odisha, damaged more than 2 million hectares of agricultural land, and resulted in more than US\$5 billion in damages along the coastline (Chhotray & Few, 2012; Mishra & Mishra, 2010). This experience prompted the creation of the Odisha State Disaster Management Authority in 1999, the publishing of the *Environmental Management Plan of Bhubaneswar* in 2003, and eventually the *Odisha Climate Change Action Plan* in 2010.

Between 2005 and 2012, Bhubaneswar was part of the United Nations Development Programme's Urban Risk Reduction project, which worked to reduce disaster vulnerabilities across city institutions. In 2012, the city, in partnership with ICLEI-Local Governments for Sustainability, initiated their vulnerability and risk assessment and adaptation planning process. This process highlighted issues of precipitation, temperature change, and extreme events as key climate risks (Interview 2013). Since 2013, Bhubaneswar has been a pilot city for the Climate Risk Management project. Supported by United Nations Development Programme and the U.S. Agency for International Development, the project support urban adaptation through focusing on institutionalization, building community-level awareness, and policy-level changes.

Throughout Bhubaneswar's engagement with these different external actors, the focus has always been on disaster risk reduction and community engagement and awareness. One important experiment is the ward-level disaster management plans. In addition to facilitating cross-departmental coordination and identifying nodal champions, ward-level plans also included school safety programs, community disaster response workshops, and – most importantly – facilitated community-based

hazard risk and vulnerability assessments (Interview 2014). As one official at the Odisha State Disaster Management Authority stressed,

‘For climate change, if people are not facing any problems, they will not recognize it as a problem for them. So you have to push them, to provide some support where they will get benefit for their projects. Only then will they take note that climate adaptation is something we have to do’ (Interview 2014).

These workshops not only created awareness around disaster risk and climate adaptation, they also helped to educate about search and rescue procedures, debris management, and other training programs.

In a second policy experiment, the city oversaw a civil defense corps trained in disaster management and response techniques. The civil defense corps is made up of volunteers and their basic duties include community protection, disaster response training programs, and assisting emergency services in the event of disasters (Interview 2013). As one corps member noted,

‘Communities are very sensitive to disasters, and they’re the people who will face the loss and will be affected. They are also the first responders. Disaster is not a regular phenomenon, but we can create some regular tasks that can be used in daily activities’ (Interview 2014).

These training programs include educating volunteers on simple search and rescue techniques that employ locally available resources, such as improvising rescue rafts using fallen trees and creating lifejackets using discarded plastic water bottles and fallen coconuts (Interview 2014).

These policy experiments showcase that, for Bhubaneswar, the overall urban agenda has framed climate adaptation in terms of immediate capacities for responding to and managing the impacts of extreme events, rather than dedicating significant investments towards addressing slow-onset effects. For example, when Cyclone Phailin struck Odisha in October 2013, public authorities were able to evacuate more than 10,000 people from slums across the city within hours of notice. Moreover, due to extensive response training programs, there were no casualties in Bhubaneswar that were directly attributable to Phailin, compared to the thousands who perished during the 1999 super cyclone. From the 198 disaster response centers, the city was able to coordinate water supply through

temporary tankers and restore electricity to critical services within three days (Interview 2014). For Bhubaneswar, processes of experimentation led to improved clarity of municipal directives for both preparing for and restoring public services immediately after impacts.

4.2. Water management and infrastructure upgrading in Indore

Indore in Madhya Pradesh has a population of approximately 2.2 million and, in the past several decades, has experienced nearly 50% decadal populations growth (Indore Municipal Corporation, 2006). Many of the city's 540 slum settlements are located along rivers and are prone to flood, waterlogging, and vector-borne diseases (Indore City Resilience Strategy, 2012). Water accessibility and distribution are Indore's most critical climate stressors (Dipak & Arti, 2011). Currently, most of Indore's water comes from the Narmada River, which is located 70 kilometers away (UN-Habitat, 2006). Under the Narmada Water Supply Scheme, water is only supplied to Indore for several hours every other day (Indore Municipal Corporation, 2006). Furthermore, 90% of water connections are unmetered and are assessed only flat charges according to the number of connections rather than the quantity of water consumed. Various assessments indicate that the demand for water in the city is increasing at the rate of nearly 5% a year (Gupta, Gupta, Singh, & Sharma, 2006).

With support from the Asian Cities Climate Change Resilience Network (ACCCRN), climate adaptation planning in Indore began in 2009, which culminated in the release of the *Indore City Resilience Strategy* in 2012. It identified issues of water, public health, and human settlements as most vulnerable and catalyzed pilot projects to address them. Experiments focused on new water harvesting and conservation technologies as well as decentralized wastewater management and treatment models (Chu, 2016). In this context, one municipal officer noted that,

'Most of city's expenses go to water management because Indore has the costliest water management system [in India]. Operations and maintenance of the system is very expensive... For all the projects, community involvement is very important. In Indore, all the projects are related to ground-level implementation, so communities are the main stakeholders in our projects' (Interview 2013).

Given these priorities, this section highlights the community-based water management and urban lakes rehabilitation experiments that are at the nexus of adaptation, water, and development.

Indore's community-based water management projects focused on water availability and quality needs in three slum settlements. In the first site, Rahul Gandhi Nagar, a reverse osmosis plant was built with direct financial support from ACCCRN and indirect institutional support – through permits and subsidies – from the Indore Municipal Corporation. The reverse osmosis plant was inaugurated in March 2013 and can treat 7,000 liters of water per day (Interview 2013). Profits from selling treated water would then be funneled back for cleaning and maintaining the plant (Chu, 2016). In a nearby second slum, because the primary source of potable water is located far away, officials built water storage tanks to provide additional household water storage capacity. Lastly, a community water-harvesting program was launched in Ganeshnagar. This program involved designing a community-wide system of collecting and storing rainwater, filtering this water through drum filters consisting of coal, sand, and brick fragments, and, finally, collecting water through common-access outflow taps (Interview 2014).

The second policy experiment in Indore is the urban lake rehabilitation program, which began in 2013. Since Indore relies on water sourced from the Narmada River, water scarcity and supply consistency problems attributed to aging infrastructure have been perennial issues (Interview 2013). In Indore, 25 urban lakes serve as complementary sources to the Narmada River, but sewage pollution and general public neglect have resulted in the severe degradation of them. This particular experiment identified four lakes for rehabilitation, which began with biodiversity and household socioeconomic surveys in the area. This then resulted in comprehensive water quality protection plans and suitability studies for constructing community sewage treatment plants in the future (Interview 2014).

Policy experiments in Indore have facilitated a renewed focus on water conservation and protection as critical urban development priorities and have catalyzed institutional change in the municipality. In particular, the city recently banned new bore wells within the city limits. Similarly, the city is mandating water harvesting be integrated into new master plans, and is offering a 6% annual property tax rebate on new commercial and residential buildings that use such technologies.

4.3. Public health capacity-building in Surat

Surat, in the western state of Gujarat, has an urban population of more than 4.5 million. Since the 1960s, Surat has experienced about 80% decadal population growth, which makes it one of the fastest growing cities in the world (ACCCRN, 2011). Surat is vulnerable sea level rise, river flooding, and urban heat (Interview 2011). The historical turning point for Surat's environmental consciousness was in 1994, when the city experienced a plague epidemic, which led to one of India's first large-scale urban sanitation and public health programs. In 2006, unusually high rainfall produced high discharges from Ukai Dam, which is situated upstream from Surat on the Tapi River. During this episode, 75% of the urban area was flooded, leading to a disease epidemic within slum neighborhoods. As a result of these major disasters, Surat's climate adaptation initiative is heavily focused on public health, flooding, water supply, and economic and industrial development (ACCCRN, 2011; Anguelovski et al., 2014; Bhat, Karanth, Dashora, & Rajasekar, 2013; Karanth & Archer, 2014).

Surat, like Indore, has been a part of ACCCRN since 2008. The city placed particular attention on stakeholder engagement and vulnerability assessment processes. These workshops relied on scenario planning exercises to identify indicators for potential adaptation interventions (Kernaghan & da Silva, 2014). Between 2010 and 2011, the city piloted an Urban Services Monitoring System that established a robust electronic platform upon which to improve the city's urban health monitoring system, particularly around incidences of malaria, dengue fever, and leptospirosis. The system included a mobile application for health data collection, a web-based mapping and data visualization tool, and a server application to store and manage data (Interview 2013). As a result, this project has facilitated the real-time collection, visualization, and analysis of data, and has further assisted different city departments with predicting disease outbreak and enabling swift response.

Surat's *City Resilience Strategy* was published in late 2010, and served as the final deliverable for ACCCRN's engagement in the city. To further develop climate adaptation and resilience actions, the Surat Climate Change Trust was formed in 2013 as a platform upon which different urban public, private, and civil society actors can contribute to prioritizing adaptation options, soliciting external financial support, and defining the city's overall adaptation agenda (Chu,

2015). One of the initial projects of the Surat Climate Change Trust is the Urban Health and Climate Resilience Center, which – like the Urban Services Monitoring System – targets the nexus of public health and climate adaptation. The Center builds on the knowledge and operating procedures Surat’s existing public health facilities as well as provides auxiliary support to state and national urban health institutions interested in engaging adaptation issues (Interview 2014). Since its launch, the Center has also facilitated an improved vector-borne disease surveillance system, hired an inter-disciplinary research team to steer and advise the city’s existing public health policies in light of climate change, and inaugurated a community-wide outreach program that promotes preventative health practices (Interview 2014).

These experiments in Surat show that urban actors are recognizing the importance of adaptation as a key component of the city’s overall socioeconomic wellbeing. As one member of the Surat Climate Change Trust noted,

‘Our objective is to understand the economic impacts of climate risks. We need to make a business case for motivating greater public and private investment in adaptation... Building urban competitiveness and urban resilience involves mitigating climate risks and integrating adaptation concerns within the city’s development priorities’ (Interview 2013).

In this vein, in early 2013, the city government adopted the issue of climate change as one of the line items included in their annual municipal budget. The line item earmarked 20 million rupees (approximately US\$300,000) per year to complement and build upon existing urban infrastructure upgrading and service enhancement efforts (Chu, 2015). These include programs for slum relocation and rehabilitation, transportation and infrastructure improvement, flood and storm water control, drinking water distribution system improvement, and wastewater management.

5. Cross-case analysis: patterns of experimentation

The embedded case studies show that there are different approaches that cities have pursued to further climate adaptation policy experiments. Informed by theories of institutional change and urban

transitions, the following cross-case analysis revolves around three themes: (1) motivations behind adaptation actions, (2) the role of actors, institutions, and governance arrangements in implementation, and (3) implications of capacity, finance, and other resources in constraining the institutionalization of adaptation experiments. A summary of these patterns is illustrated in Table 3.

[TABLE 3 HERE]

5.1. Factors driving early adoption

Although adaptation priorities are only nascent concerns, agenda items around improving public services, infrastructure, and urban security are not new. The experiments described in this paper all note that the ability of cities to implement adaptation projects requires innovative planning and decision-making methodologies that take into account local socioeconomic and environmental conditions, even when transnational actors are involved in the initial and enabling stages (Bulkeley et al., 2015; Carmin et al., 2012). For the Indian context in particular, the local agenda has been on industrialization and economic development, where sustainability and climate protection has come to mean safeguarding economic systems and associating infrastructures (Atteridge et al., 2012; Mukhopadhyay & Revi, 2009).

This trend can be observed in the three case cities. In Bhubaneswar, policy experiments focused on disaster risk reduction and management, which is a sensible strategy given the city's historic vulnerability to extreme weather events such as cyclones. Therefore adaptation experiments are motivated by an overall interest in protecting infrastructure and physical assets against risks and providing response and rehabilitation services after particular impacts. In Indore, the developmental challenge has been safeguarding water resources and upgrading urban infrastructures. Adaptation, in this case, came to mean ensuring water supplies for urban consumption and improving existing waste management systems. Lastly, for Surat, the main motivator for adaptation was the need to improve public health, reduce the city's overall risk profile, and protect urban infrastructures in the event of

flooding. This led to projects around improving public health research and targeting investments at associating data management and geospatial mapping techniques.

In these cities, development objectives around infrastructure protection have overshadowed other livelihoods, poverty reduction, and social justice agendas. This reflects local governments' interest in articulating adaptation options that yield tangible local benefits. For these cities, the overriding motivation is the ability to further immediate growth-oriented development projects, facilitate private capital investment, and address existing urban infrastructure and service deficits. As one Surat Municipal Corporation officer argued,

‘What is important is funding from civil society and public and private sectors, particularly in terms of capital investments in Surat. These are in areas of insurance, healthcare, waste and sanitation, water management, affordable housing, and micro-finance. These are areas which capital can be created and can come into this area’ (Interview 2013).

The tradeoffs here, therefore, are not necessarily between climate and development agendas, but between near-term economic benefits and long-term equitable development objectives.

5.2. Implementation pathways, institutions, and governance

The case studies point to a variety of institutional and participatory pathways through which experiments are eventually implemented. As highlighted in existing literature on institutional change, the diversity of actors involved in decision-making promotes a deliberative problem-solving mentality (Briggs, 2008; Fung, 2015). Adaptation planning processes not only bring particular institutional and socioeconomic interests to the fore, it can also legitimize the process by ensuring procedural justice (Paavola & Adger, 2006; Shi et al., 2016). In India, although many local stakeholders lack access to specific climate projections (Few, Brown, & Tompkins, 2007), local actors are often cognizant of local livelihoods, infrastructural, and economic development needs (Chu et al., 2015).

One common enabling factor across the three cities is the presence of international actors, who are supporting cities in assessing risks and developing plans and strategies (Anguelovski &

Carmin, 2011; Kernaghan & da Silva, 2014). The case studies show that local governments are indeed utilizing the capacity and resource support provided by these external networks, especially since cities tend to be financially constrained. But since external interventions are not enough to ensure the sustainability of adaptation projects across time or to enact broad-ranging programmatic change within city government, Bhubaneswar, Indore, and Surat have all enlisted support from local civil society and private actors to further legitimize and facilitate policy experiments.

In Bhubaneswar, adaptation experiments relied on community-based strategies that involved concerned community members, service delivery professionals, and support from external agents. The success of disaster risk projects depended on their ability to raise awareness of impacts across slum settlements. In Indore, water projects combined community support, local government incentives, and planners and engineers with knowledge of the local infrastructure. Finally, in Surat, public health experiments succeeded because of constant engagement from international actors and capacity and resource support from local research institutions. In all three cities, the local government played a pivotal role in providing an institutional home for emerging adaptation priorities, but the different strategies for implementing experiments relied on extensive networks of public, private, and civil society actors whose constant engagement with each other revealed opportunities for integrating adaptation and development objectives. Experiments therefore became a method to bridge governance capacity deficits and resource constraints.

Interactive and iterative engagement processes between different urban actors and institutions have shifted the public's understanding of climate and development away from juxtaposing particular environmental tradeoffs and towards collective framings of maximizing project complementarities and institutional interests. These complementarities are articulated based on a city's overall developmental agenda, such as disaster management in Bhubaneswar, water management in Indore, and public health in Surat. To achieve such common framings that produce synergistic experiments, there exist interactive processes that uncover, reframe, and prioritize co-benefits between adaptation and development. These experimental processes mostly exist outside of local government decision-making and, as highlighted in the case descriptions themselves, are driven strongly by private and civil society interventions.

5.3. Barriers to institutionalization

Finally, the cases studies have shown that experiments are critical for testing ideas, quantifying co-benefits, and navigating through different participatory governance arrangements. Still, there is little evidence to show that these experiments are being embedded into urban policies to affect programmatic change. For example, disaster management experiments in Bhubaneswar have only catalyzed incremental and siloed changes to how the city plans for extreme events. Similarly, public health interventions in Surat have only resulted in sector-specific climate adaptive behaviors rather than facilitating cross-sectoral approaches. As a result, without institutionalization, adaptive capacities will be built only within discrete sectors, actors, and locations, rather than towards improving the urban socioeconomic system as a whole.

There are also different barriers that need to be overcome if adaptation experiments are to be institutionalized. First, even with additional resource support from external agents, local governments find it difficult to financially sustain experiments over the long term (Carmin, Dodman, & Chu, 2013). For Bhubaneswar, Indore, and Surat, initial seed funds were derived from creatively navigating external resources and intergovernmental transfers, including grants provided by the Jawaharlal Nehru National Urban Renewal Mission.² This money enabled pilot projects and experiments in the outset, but local governments incur additional incremental maintenance and upkeep costs in the future. As one ACCCRN consultant noted,

‘[It] was more of a reaction that cities came onboard. Surat already had flooding problems and Indore has water supply stress issues. The pilot project funding was an essential component as it was a carrot for the city to come onboard. It required money, specific capacity building, or handholding for long periods of time. Otherwise cities could not relate climate to environmental or disaster management issues that they are dealing with on an everyday basis. This is something very new’ (Interview 2013).

As a remedial cost-saving measure, most cities have also elected not to pursue costly large-scale urban upgrading and infrastructure projects. Since experiments tend to be time-bound and location specific, this approach helps control costs, ensures effective and accountable implementation, and

clarifies combinations of funding channels.

Lastly, and most importantly, despite their general success, issues of equity and social justice have not been adequately addressed in most climate adaptation experiments. While focusing specifically on ensuring the city's overall infrastructure development, many projects have neglected to tackle issues of poverty reduction and livelihoods security. For example, focusing only on public health interventions in Surat may result in the diversion of local government attention away from other critical adaptation needs such as addressing chronic poverty among the migrant community and improving public service delivery to slums. These indirect institutional costs threaten the long-term trajectory of experimentation and prevent equitable inclusion of experiments into urban policies.

6. Conclusion

This paper, through critically assessing six climate adaptation experiments in Bhubaneswar, Indore, and Surat, contributes to understanding the politics behind how local governments in India conceive of, reframe, and ultimately implement interventions that balance climate adaptation and urban development objectives. The results note that, in order to gain awareness, adaptation policy experiments must be framed around tangible needs with visible near-term benefits. Therefore, in support of existing theories of institutional change and urban transitions, I find that policy experiments allow local governments to test out adaptation options that are most suitable for the city's existing development context (Anguelovski et al., 2014).

The embedded and cross-case analyses also note that the public's understanding of climate change is no longer framed around juxtaposing climate and development tradeoffs, but is in fact framed around maximizing project complementarities. The ability to implement experiments at the nexus of adaptation and development, therefore, is enabled by a interactive process of framing (and reframing) synergistic interests amongst associating public, private, and civil society actors. This interaction allows for the expressing of particular sets of institutional interests and, subsequently, the maximizing of specific climate and development complementarities. This finding advances theories of

policy experimentation by highlighting the implications of experimentation in uncertain, contentious, and fragmented governance landscapes that characterize many cities in the global South.

Finally, although existing literature on policy experiments argues that they allow local governments to test ideas, quantify specific co-benefits, and navigate particular governance arrangements (Bulkeley et al., 2015; Cárdenas, 2009; Rondinelli, 1983), I also note that a project-oriented approach that negates the wider political economic context cannot yield sustained engagement. For example, many experiments can result in protecting economic systems and associating infrastructures rather than focusing on equitable development, poverty reduction, and justice and rights. To further the effectiveness, legitimacy, and inclusiveness of urban climate adaptation processes, cities must design more collaborative approaches that incorporate climate adaptation and development needs of the most environmentally and socioeconomically vulnerable sections of society. Theories and approaches to policy experimentation must therefore also include correspondingly robust mechanisms to ensure social justice and equity.

Appendix: List of interviews

1. Vice President, South Gujarat Chamber of Commerce and Industry, Surat, 10 January 2011
2. Director, Urban Social Health Advocacy Alliance, Surat, 11 January 2011
3. Officer in Urban Development Department, Surat Municipal Corporation, Surat, 17 January 2011
4. Town Planner, Surat Urban Development Authority, Surat, 26 January 2011
5. Vice President, Surat Climate Change Trust, Surat, 14 March 2013
6. Director, Urban Health and Climate Resilience Center, Surat, 14 March 2013
7. Scientist, Center for Social Studies, Surat, 15 March 2013
8. Officer in National Urban Renewal Mission Cell, Surat Municipal Corporation, Surat, 11 June 2013
9. Chief Engineer, Surat Municipal Corporation, Surat, 12 June 2013
10. Consultant, TARU-Leading Edge, Indore, 1 August 2013
11. Under-Secretary, Indore Municipal Corporation, Indore, 2 August 2013
12. Officer in Environment Department, Indore Municipal Corporation, Indore, 2 August 2013
13. Officer, Madhya Pradesh Electricity Board, Indore, 3 September 2013
14. Secretary, Association for the Advancement of Society, Indore, 3 September 2013
15. Scientist, Shri Govindram Seksaria Institute of Technology and Science, Indore, 4 September 2013
16. Officer in Urban Department, Indore Municipal Corporation, Indore, 5 September 2013
17. Director, Indian Meteorological Department, Bhubaneswar, 13 January 2014
18. Officer, Odisha State Department of Civil Defense, Bhubaneswar, 13 January 2014
19. Officer in Urban Department, Bhubaneswar Municipal Corporation, Bhubaneswar, 13 January 2014
20. Officer, Odisha State Department of Water Resources, Bhubaneswar, 13 January 2014
21. Manager, Odisha State Disaster Management Authority, Bhubaneswar, 15 January 2014
22. Officer, Odisha State Department of Health, Bhubaneswar, 15 January 2014

23. Community Organizer, Indore Urban Development Authority, Indore, 29 May 2014
24. Managing Director, Odisha State Disaster Management Authority, Bhubaneswar, 3 June 2014
25. Office in Environment Department, Bhubaneswar Municipal Corporation, Bhubaneswar, 4 June 2014

Notes

¹ The Rockefeller Foundation's Asian Cities Climate Change Resilience Network (ACCCRN) program was a 9-year, US\$59 million initiative designed to build climate resilience in cities in Asia. Between 2008 and 2012, the program worked intensively with 10 cities across India, Indonesia, Thailand, and Vietnam to develop city climate resilience strategies.

² Launched in December 2005, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) supported local governments to plan and develop cities, facilitate economic development, and improve the quality of life of residents. JNNURM incentivized reforms through linking critical infrastructure and public service development projects with conditional fiscal transfers from state and national governments. Phase I of JNNURM ended in 2014.

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City/Indicator	Bhubaneswar	Indore	Surat
State	Odisha	Madhya Pradesh	Gujarat
Urban Pop. (2011)	880,000	2,200,000	4,500,000
Key Climate Impacts	Heatwaves, cyclones, flooding	Water scarcity, river flooding, diseases	Flooding, diseases, sea level rise
Key Development Pressures	Urbanization, migration, infrastructure	Urbanization, migration, water infrastructure	Urbanization, migration, infrastructure pressures
Key City Institutions	Bhubaneswar Municipal Corporation, Odisha State Disaster Management Authority	Indore Municipal Corporation, Indore Development Authority	Surat Municipal Corporation, Southern Gujarat Chamber of Commerce and Industry, Surat Climate Change Trust
Key External Actors	United Nations Development Programme, U.S. Agency for International Development	Asian Cities Climate Change Resilience Network, U.K. Department for International Development	Asian Cities Climate Change Resilience Network
Key Urban Climate Policies	<i>Bhubaneswar Climate Resilience Strategy (2013)</i>	<i>Indore City Resilience Strategy for Changing Climate Scenarios (2012)</i>	<i>Surat Climate Resilience Strategy (2011)</i>

Table 1. Key city indicators

City/Project	Objectives
Bhubaneswar: Ward-level disaster management plans	Create ward-level disaster management committees and implement community disaster response workshops, school safety programs, community risk and vulnerability assessments, and disaster response training programs.
Bhubaneswar: Civil defense corps	Solicit volunteers for community protection during disaster events. Neighborhood educational workshops for disaster response, training programs and drills, and assisting emergency services.
Indore: Community-base water management	Improve water availability and quality across slums. Building a reverse osmosis facility, disseminating water storage tanks, and implementing rainwater harvesting experiments.
Indore: Urban lakes conservation and rehabilitation	Protect and rehabilitate urban water sources and storage facilities, water quality protection plans, and sustainable use studies.
Surat: Urban services monitoring system	Design a climate resilience and disease monitoring system that provides timely information about water quality and disease outbreaks.
Surat: Urban Health and Climate Resilience Center	Establish a center to improve the urban health management system using evidence-based research, improving disease surveillance techniques, and updating operational procedures.

Table 2. List of climate adaptation policy experiments

	Bhubaneswar	Indore	Surat
Framing			
Motivations	Disaster risk reduction, risk management, hazard mitigation.	Ensuring access and availability of water resources, upgrading urban infrastructures.	Improve public health and reduce the city's risk profile. Protect urban infrastructures.
Co-Benefits	Protect infrastructure and investments against damage. Response and rehabilitation after extreme events.	Water supply protection and development for urban consumption. Improving solid waste management.	Public health research and investments in urban data management and visualization techniques.
Implementation Pathway			
Strategy	Integrate adaptation into city and community disaster risk management plans.	Support community water management and conservation programs.	Embed adaptation into urban institutions such as the Surat Climate Change Trust.
Participation	Local strategies involving community members, service delivery professionals, and external agents.	Community support, government incentives, and planners and engineers with local knowledge.	Engagement with international actors. Support from research institutions
Barriers	Project-focus only catalyzed incremental changes. Over-reliance on external support.	Difficulty in sustaining leadership and inability to coordinate cross-jurisdictional planning.	Focus on promoting sector-specific adaptation. Lack of inclusive processes to promote equity and justice.

Table 3. Summary analysis of urban climate adaptation policy experiments