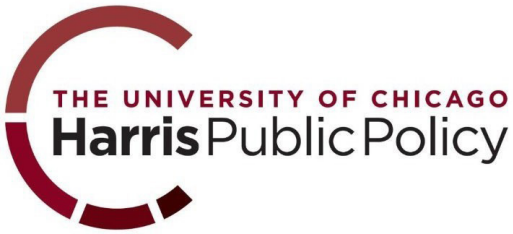
INTER-POLICY
SCHOOL SUMMIT
at Harris Public Policy

CITY RESILIENCY AND CLIMATE CHANGE

A REPORT FROM THE INTER-POLICY SCHOOL SUMMIT 2020



THE UNIVERSITY OF CHICAGO
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THE ASPEN INSTITUTE
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PROGRAM

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FOREWORD

As climate change alters our environment and causes increased instances of extreme weather, cities around the world are faced with new, damaging, and often life-threatening weather events. Dangerous flooding, superstorms, unprecedented heat waves, and raging forest fires are just a few of the climate change-related phenomena that present challenges to cities' infrastructures and disaster response abilities. Vulnerable cities around the world need actionable sustainability and resilience plans to protect the health and safety of their citizens. While many cities may understand the need to act, they often face obstacles, such as lack of resources, expertise, manpower, or political will to find and implement the most effective or innovative solutions.

The Inter-Policy School Summit is a student-run conference hosted by the University of Chicago Harris School of Public Policy. The Summit brings together graduate students from around the world each year to propose solutions to pressing global issues. The 2020 Summit was held February 28 - March 1, 2020. Graduate students from twenty universities in four countries gathered together to explore innovative strategies to address the issue of City Resiliency and Climate Change with the goal of identifying potential solutions to help urban areas adapt to climate change-related challenges.

At the Summit, participants were assigned into groups, each examining this issue in the context of a particular city. The cities included were: **Lagos**, Nigeria; **Wollongong**, Australia; **Jakarta**, Indonesia; **Venice**, Italy; **Ho Chi Minh City**, Vietnam; **San Juan**, Puerto Rico, USA; **Delhi**, India; **Santiago**, Chile; and **Buffalo**, New York, USA. These cities were specifically chosen because of the variety of climate challenges they face including coastal flooding, wildfires, extreme heat, and potential in-migration of climate refugees. These briefs present the findings of each group.

We would like to thank Greg Gershuny, Anna Giorgi, and Kate Jaffee from the Aspen Institute Energy and Environment Program for their support and expert contributions to the Summit. We are also grateful to our speakers and panelists for their contribution to our program: Malu Blázquez, LeeAnn Tomas-Foster, Allison Arwady, and Jeb Brugmann. Thank you to the content area experts who gave their time to advise participants or facilitate workshops: Katherine Baird, Amir Jina, Mary Michaud, Tavares Williams, Dylan Madden, John Zhang, Kaiti Zolton, and Justin Behrens. Finally, thank you to the Harris School for its support and resources, especially to Dean Katherine Baicker and our advisor, Adam McGriffin.

We acknowledge and thank our sponsors for their financial support: the Energy Policy Institute at the University of Chicago (EPIC), the Pearson Institute for the Study and Resolution of Global Conflict, the Mansueto Institute for Urban Innovation, Arcadis, Harris Student Government, UChicago Graduate Council, the Harris Energy and Environmental Association (HEEA), the Harris School Dean's Office, the Harris Career Development Office, the France Chicago Center, and West Monroe Partners.

The 2020 Executive Board of the Inter-Policy School Summit
University of Chicago, Harris School of Public Policy

BUFFALO: WHERE COMMUNITY RESILIENCE IS CLIMATE RESILIENCE

Written by: Michelle Brann, Rachael Chambers, Paelina DeStephano, and Kate Donatelli

EXECUTIVE SUMMARY

As a city that will largely be shielded by climate change's most devastating impacts, Buffalo may become a climate haven, attracting people escaping from more impacted locales. These flows are highly uncertain, and Buffalo has focused its resiliency efforts on traditional climate adaptation and economic development. However, the city can work to build social capital and community resilience, strengthening Buffalo's ability to face emerging climate and migration events. Any recommendations to improve resilience should adapt to uncertainty through flexibility and deliver short-term and long-term benefits. Buffalo should engage in community-driven resilience planning to identify localized needs and encourage neighborhood-level social cohesion. The city should also adopt a suite of affordable housing policies to prevent displacement and further maintain the social fabric of Buffalo's neighborhoods.

I. RELEVANT BACKGROUND INFORMATION

Buffalo, New York is characterized by its industrial past. In 1950, the city's population peaked at 580,000. However, as deindustrialization swept across the Rust Belt, several major employers shuttered operations (*Buffalo, New York Population 2020 (Demographics, Maps, Graphs)*, 2020), starting a pattern of outmigration that continues in Buffalo to this day. In 2016, the city experienced negative net migration of 0.5 percent. Today, Buffalo is home to 256,300 people, less than half of its peak population, leaving an underutilized infrastructure system, empty homes, and ample opportunity for development and regrowth, especially in the city center (Dewey, 2019).

From a climate perspective, Buffalo is uniquely insulated from many of the shocks other U.S. cities are projected to encounter. Regional climate projections demonstrate more frequent and intense heat waves, flooding events, and lake-effect snowfall (Magavern & Schneekloth, 2017). However, ample freshwater and farmland, its inland location, and lack of natural disasters like hurricanes and earthquakes may buffer the city from the worst effects of climate change (Nussbaumer, 2018). These climatic and geographic advantages, combined with the city's surplus infrastructure, have led some to speculate that Buffalo may become a climate haven in the face of global environmental change (Nussbaumer, 2018). The city, which used to house double its current population, could be a refuge for an influx of migrants, either those moving to secure climate- insulated investments in the region or by those escaping climate disasters elsewhere (Deaton, 2019).

Preparing for this future growth is an essential component of climate adaptation. However, Buffalo's resilience is dependent on more than just economic development. In order to build resilience, Buffalo must make a concerted effort to build the capacity of existing residents to direct how their community

transforms. Social cohesion will be necessary for Buffalo to grow equitably and sustainably. There are presently severe disparities within Buffalo, predominantly impacting people of color in low-income neighborhoods, that must be addressed before the city can effectively serve as a climate haven (Tripathi & Zemsky, 2013). By understanding that community resilience is climate resilience, Buffalo can ensure that its current residents are not displaced by, and can potentially benefit from, future climate-induced growth.

II. CURRENT STATUS OF CLIMATE RESILIENCE

Buffalo acknowledges gaps and disparities that residents face and is working to address them through a climate resilience lens. The region is well-resourced with a combination of government and non-profit groups, including community groups and academic partnerships. Buffalo has a long history of environmental advocacy, including work from the Friends of Olmsted Parks, Friends of the Buffalo River, and the Sierra Club Niagara Group. These organizations have pushed the city to adopt greater climate-focused practices and policies (Magavern & Schneekloth, 2017).

The Climate Justice Pledge drives action in the city and promotes continued action to prioritize climate at the intersection of social and economic challenges. The pledge stresses building alliances between leaders in public and private entities of all kinds, including religious, cultural, and educational platforms, but lacks legislative teeth and is an advocacy body ("Climate Justice Coalition," 2015). The organization relies heavily on voluntary support, which can sometimes hamper community efforts to build broader coalitions when institutional knowledge is lost as organizers move away.

Civic and economic nonprofits are a key part of Buffalo's landscape, and include: the Western New York Climate Action Coalition, Partnership for the Public Good, the Western New York Environmental Alliance, PUSH Buffalo, and the Clean Air Coalition. In particular, People United for Sustainable Housing, or PUSH Buffalo is an organization that marries environmental and social concerns throughout the city (*Push Buffalo – Welcome to PUSH Buffalo*, 2020). Their mission, "to mobilize residents to create strong neighborhoods with quality, affordable housing; to expand local hiring opportunities; and to advance economic and environmental justice in Buffalo," is reflected in their most recent project to build capacity through a new anti-displacement learning network (Bono, 2020). There is no current data around the efficacy of the program, so monitoring the progress and implementation will be important for determining disparity alleviation.

While the size and timing of climate migration is nearly impossible to predict, Buffalo is already preparing for future growth. The city's award-winning Green Code addresses Buffalo's need to mitigate and adapt to climate change (*Buffalo Green Code Unified Development Ordinance*, 2017). Additionally, there are several initiatives, most notably the state-funded Buffalo Billion program, designed to spur economic development in the region (Tripathi & Zemsky, 2013).

Buffalo does engage in municipal and regional resiliency planning efforts, most recently seen through the development of the city's 2006 Comprehensive Plan and One Region Forward planning documents. However, macro-level planning efforts can erase spatial distinctions and increase inequity and exclusion (Anguelovski et al., 2016). The city has significant spatial variability in its risks and resources. And while the city launched the Good Neighbors Planning Alliance (GNPA), only two of the eleven planning areas have submitted plans.

The city is aware that housing is a large concern for many of its residents and has newly enacted a community land trust and foreclosure assistance program (*Buffalo City's Mayor Announces Launch Of Foreclosure Assistance Program*, 2019) geared at helping those purchase and remain in their homes. The Fruit Belt Community Land Trust, formed with the support of the Buffalo Common Council, acts as a developer of properties purchased from the city. Several non- profit organizations, including Open Buffalo and PUSH Buffalo assisted with the formation of and continue to be involved in the Land Trust (*A Plan that Bears Fruit*, 2016). The success of these programs is unclear. In 2018 the Land Trust received only 20 of the city's over 200 vacant lots (Robinson, 2018). As of 2020, the Land Trust has not received any additional vacant land plots and there aren't currently homes on these lots.

III. PROPOSED POLICY SOLUTIONS

Though climate impact modeling becomes increasingly sophisticated, the exact challenges are characterized by uncertainty. Climate migration, extreme winter storms, heat waves, and flooding may impact Buffalo, but the timing and severity is unpredictable. Because of this uncertainty, these recommendations are designed to deliver short- and long-term benefits to Buffalo, even if significant climate migration never materializes.

Resiliency Planning for Social Cohesion

When extreme events occur, they can strain the ability of governments to respond. Communities play a crucial role in meeting emerging needs and can serve as a network, providing localized support to foster resiliency. Developing social and political capital through participatory planning processes better equips communities to serve this vital role.

Neighborhood Planning Groups

By developing systems to support grassroots planning structures, Buffalo can build social capital within communities and identify the needs of its diverse populations. A system of Neighborhood Planning Groups (NPGs) could serve as a formalized mechanism to conduct outreach and assess community needs and assets in each neighborhood of Buffalo. Buffalo's system of Block Clubs and vibrant civil society can be leveraged to develop the groups through a request for propoal process, avoiding duplicating efforts and building on the networks that organizations like PUSH Buffalo have developed.

Assets and Vulnerability Assessment

While NPGs would have flexibility in deciding how to conduct outreach, they would be responsible for working with city officials to complete a formal assets and vulnerability assessment. This assessment could be patterned after the community-driven planning framework developed by the National Association of Climate Resilience Planners, which details principles, practices, and resources for the planning process (Gonzalez, 2017). By surveying the community and working with city officials, NPGs can identify and elevate emerging issues and develop emergency preparedness plans. As needs are identified and prioritized, NPGs can develop action plans that tap resources at the individual, community, and city level. For example, neighbors could establish plans to check on elderly and vulnerable populations during heat waves or city officials could connect flood-prone areas with available green stormwater infrastructure funding. NPG planning processes should also document community assets – local skills and resources that can help to realize action plans. Intentionally documenting assets can also foster creativity in the face of resource constraints and avoids deficit-based planning. This process should be iterative, occurring on a regular basis to address the shifting climate change challenges.

The city should also explore dedicating permanent funding to assist in deploying NPG- identified solutions. Resurrecting participatory budgeting or directing community block grants to resiliency efforts can motivate participation in the planning process.

Logistical Consideration

The Division of Community Planning would be a natural fit for coordinating this program with the input of important stakeholders like the Office of New Americans and the Office of Strategic Planning. To minimize budgetary impact, Buffalo could stagger implementation, conducting planning with a few communities each year. Finally, Buffalo should ensure that the community planning effort is a well-publicized initiative to promote participation. Aligning the goals of current planning efforts with this program can reduce funding requirements, or the city could apply for funding through Climate Smart Communities planning grants or Community Development Block Grants.

Strengthening Community Through Homeownership

No matter how the impacts of climate change play out in Buffalo, the city's resilience will depend on strong, stable communities. Studies demonstrate a correlation between homeownership and higher participation in community organizations, greater activism around neighborhood causes, and more investment in the local environment (Rohe & Stewart 1996, Cox 1982, DiPasquale & Glaeser 1999). By reducing rates of outmigration, homeownership will also preserve the outcomes of the planning process described in the section above. To build resilience through homeownership, Buffalo must develop strategies to prevent homeowner displacement and increase rates of homeownership with improved affordability.

In order to help owners remain in their homes, Buffalo could enact a community-based foreclosure prevention program, sponsored by a private foundation or non-profit. These programs include counseling, budgeting, financial assistance, and advocacy to help homeowners become less likely to experience another foreclosure event in the future (R. Quercia & Cowan, 2008). Administering this program is less expensive per home (~$3,000) than the equivalent cost of a foreclosed property when calculating back taxes, lawyers, time, and foreclosure fees (~$26,000) (R. G. Quercia et al., 2004).

Since it may not be possible to limit all foreclosures, Buffalo could also enact a Foreclosure Mediation Program, to find mutually beneficial alternatives to foreclosure (e.g. short sale, deed in lieu of foreclosure or repayment plan). These programs are common, successful, and are generally funded through lender fees or state financing. Studies from various US jurisdictions found that 61- 89% of participants in mediation programs avoided foreclosures. (Clifford, 2011). Mediation programs are low cost compared to other programs, and have great potential to reach Buffalo residents in danger of losing their homes.

Preventing displacement will protect existing homeowners, but improving community resilience will require increasing rates of homeownership in Buffalo. To do this, the city could pursue shared-equity homeownership models, including restrictive covenants and community land trusts. (Masson, 2014). Used in conjunction with zoning, restrictive covenants can be customized to dictate future land use based on community priorities (see Appendix I for characteristics of successful restrictive covenant programs) (Kazis, 2015).

Cities have overcome the administrative challenges of deed restrictions by pairing them with a community land trust. The community land trust would then be responsible for monitoring properties for acceptable uses, administering homeowner education programs, ensuring deed restrictions enforcement, and providing other services to homeowners. The non-profit Chicago Community Land Trust has successfully applied this model to ensure that homes are sold to income-qualified buyers. (Towey, 2009). With existing institutional knowledge from the Fruit Belt Community Land Trust and over 300 city-owned properties, Buffalo may be able to create additional land trusts in other priority areas of the city, including the West Side, which has recently been impacted by increased developer interest and tax hikes from reassessment (Dewey, 2019a).

The Fruit Belt Community Land Trust, like many other city initiatives, is left vulnerable by its reliance on state funding. While Buffalo may be insulated from some of the more severe impacts of climate change, other parts of the state are not. Future hurricanes, floods, or other events in New York could jeopardize a large portion of Buffalo's funding. Although the Land Trust receives some funding from non-profit groups and the Common Council, in recent years the majority of its funding came from state grants (Williams, 2019). While the state grants are, in some cases, transformative, a resilient affordable housing program should diversify its funding sources. Other cities support their affordable housing programs with housing trust funds that are fed by dedicated funding streams. Although civic groups have advocated for a housing trust fund in Buffalo, the city does not yet have one (*A Plan that Bears Fruit*, 2016). However, there may be an opportunity to create a dedicated funding stream through a demolition tax and condo conversion fee. These taxes are common in cities like Buffalo that have aging housing stocks (*Demolition taxes and condominium conversion fees,* n.d.). The taxes and fees are flexible based on the size and number of units in the existing structure.

Co-benefits

Community-driven planning has the direct benefit of improving climate resiliency, but it also provides co-benefits including improved social cohesion. Planning processes build social capital through articulating shared goals and re-affirming basic values (Crawford et al, 2008). A study in Chicago found that social cohesion increased the resiliency of communities, demonstrated by lower mortality in an extreme heat wave (Baussan, 2015). Similar findings in rural Canada and hurricane-impacted communities bolster this connection (Adger et al., 2005; Townshend et al., 2015). The social networks established through the planning process can also provide entry points for welcoming climate migrants. Similarly, homeownership, while strengthening the community and supporting the planning process, also has the additional benefit of providing substantial social as well as economic benefits (Yun & Evangelou, 2016). Homeowners have additional security, increased self-esteem, and a less stressful and thus healthier life (Yun & Evangelou, 2016). These benefits will ensure that Buffalo thrives in the face of climate resilience.

CONCLUSION

Resilience is a multifaceted lens through which cities like Buffalo can best prepare for the uncertain future that climate change will create. By building strong institutions and frameworks to support social cohesion and community resilience, Buffalo can better adapt when the likelihood of climate-driven migration brings new populations to the city. Housing and community strengthening will make Buffalo a national asset, both as an example for other cities and as a climate haven. At present, environmental experts foresee climate disasters displacing roughly a billion people globally by 2050; in the United States, they foresee sea level rise alone displacing over 13 million by 2100, with greater impacts when accounting for storms, droughts, heat intensity, and more (Bassetti, 2019; Milman, Oliver, 2018). In order to be the "Climate Refugee City" that Mayor Byron Brown described in his 2019 state of the city, Buffalo must act now to support a vibrant economy built on social cohesion and civic engagement (Deaton, 2019). Buffalo can rise to the occasion, but it will require tangible action throughout the community to ensure that no one is left behind.

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SUGGESTIONS FOR ADDITIONAL RESOURCES:

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https://groundedsolutions.org/tools-for-success/resource-library/community-land-trust-technical- manual

APPENDIX I

Components of successful restrictive covenant programs:

- Working with neighborhoods to identify parcels that should be subject to a restrictive covenant.
- Capping the future sale price of a home to preserve affordability while allowing the owner to build wealth. Common resale formulae include pricing homes based on increases to area median income or based on market value appreciation of comparable homes (*Deed- restricted homeownership programs,* n.d.). Further, "affordability" should be defined with respect to the City of Buffalo, and not Erie County or the greater metropolitan area.
- Requirements that future buyers fall below a certain income threshold, generally expressed as a percentage of the area median income. Cities can tailor these restrictions based on location-specific conditions. For example, the Bay Area city of Novato, CA uses a threshold of 120 percent of the median income to account for the high cost of living (*City of Novato*, n.d.). In cities like Buffalo, where extremely high utility costs offset relatively low costs of living (Partnership for the Public Good & Open Buffalo, 2017), a low threshold may be appropriate.
- Restrictions on acceptable uses. For example, many restrictive covenants require owners to occupy a unit as their primary residence and place restrictions on subletting in order to preserve neighborhood stability (Davis, 2006).
- Homebuyer education or counseling programs to help people determine if homeownership is a good fit for them, identify barriers to homeownership, and access products and services that make homeownership more affordable (*Housing education and counseling*, n.d.).The City of Somerville, MA requires prospective buyers of deed-restricted units to complete courses co-run through a public-private partnership (*Upcoming Workshops*, n.d.).
- A strong monitoring and enforcement program to ensure that deed restrictions are upheld and to protect owners of deed-restricted properties from foreclosure, as this can wipe out the deed restriction. A Regional Coalition for Housing (ARCH) program manages a database of deed-restricted properties in the Seattle metropolitan area to monitor their resale and enforce affordability requirements (Davis, 2006).

EQUITABLE CLIMATE SOLUTIONS FOR DELHI: POLICY TOOLS FOCUSED ON INFORMAL COMMUNITIES

Written by: Kelly Aves[1], Jake McDermott[2], and Joselyn Molina[3]

EXECUTIVE SUMMARY

Climate resiliency is traditionally defined as the ability to recover from natural disasters. In this memo, we shift this definition to a focus on mitigating real-time climate impacts on human populations. Functionally, this means adapting to future climate impacts in a way that prioritizes the ability of a community to remain as they were and withstand such impacts, rather than allowing communities to "bounce back" after experiencing climate related trauma. A large proportion (33- 47%) of Delhi's population lives in informal settlements (Karamchandani Chennuri, & Jain, 2016), which often have inadequate access to basic services such as water and electricity, making them particularly vulnerable to climate impacts (i.e., extended drought and flooding). These communities will face the same climate impacts as the rest of Delhi, but their impacts will be pronounced due to their inadequate access to basic necessities.

Thus, we argue that Delhi's climate resilience plans must prioritize resilience in informal settlements. Within these settlements, we conceive of physical resilience as the resilience of the actual infrastructure; community resilience as the community's access to healthcare, food, and water resources. We therefore emphasize capacity building, the community's ability to establish the needed resources and knowledge to complete infrastructure projects, for marginalized populations. Through capacity building, we hope that communities gain the tools needed to implement climate resiliency projects. We therefore recommend that Delhi conduct a transparent stakeholder-driven process that prioritizes the particular needs of residents in informal settlements and results in an equitable distribution of future climate resiliency and adaptation projects by the following initiatives:

Immediate term:

- Freshwater mapping within informal settlements
- Green Infrastructure
- Community partnerships and microgrants

Long term:

- Grey Infrastructure for stormwater and sanitation
- Political capacity building
- Pathway for legal housing tenure in JJ clusters.

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BACKGROUND

Delhi is one of the world's most rapidly urbanizing cities with a population of approximately 19M ("Census," 2011). Despite it currently having a "semi-arid climate, with hot summers [and] average rainfall" (State Action Plan on Climate Change (SAPCC), 2019, p. 27), climate projections show an expected rise in annual mean temperatures between 2.5-5°C, with more warming in northern India where Delhi is located (SAPCC, 2019). Climate related impacts of warming will manifest as increased intensity of extreme rainfall and increased frequency of heatwaves and droughts (SAPCC, 2019), only to be more deadly as the city continues to grow.

Of particular concern are the vulnerabilities faced by residents of informal settlements. Seven different settlement types are present within Delhi, ranging in degrees of formality, legality, land tenure, and infrastructure access, complicating climate resilience planning in the city (see A.1). Particularly challenging are the jhuggi jhopri (JJ) clusters. Home to 15% of Delhi's population, these non-designated slum areas occupy public lands with no infrastructure or legal status (Sheikh et al., 2014). The Intergovernmental Panel on Climate Change's Fifth Assessment Report highlights the increased vulnerability of low-income communities to climate change associated risks, with significantly weaker adaptation and coping strategies relative to higher income populations (IPCC, 2014, p. 97). In Delhi, this is particularly apparent among residents of informal settlements, who face risks from extreme heat events, flooding and disease, and droughts (World Bank, 2013, p.10). Most of Delhi's existing adaptation work has focused on the city's ability to respond to a number of different climate related areas (food, water, energy, transportation, urban planning) without fully considering the needs of its resettled and informal populations.

Since the 1960s, the Delhi government has resettled residents of JJ clusters. Slum removal is driven by the heterogeneous distribution of informal settlements in Delhi, in which informal settlements are located adjacent to wealthier neighborhoods (Sheikh et al., 2014). Resettlement removes residents from the city center to the periphery, disrupting community support networks and limiting access to basic services and public transit. Furthermore, resettlement colonies, while formally planned, often lack the promised infrastructure, limiting capacity to withstand climate change-driven impacts like heat waves, flooding, and drought.

CURRENT STATUS

The city of Delhi has undertaken several planning and adaptation projects. Within its 2019 State Action Plan on Climate Change (SAPCC), the city outlines 36 key action areas and subsequent work. The SAPCC addresses many environmental concerns such as biodiversity, green space, air pollution, clean energy, agriculture, and water resources. By creating the SAPCC, Delhi hopes to provide an iterative policy framework that can evolve over time with the needs and developments of local, state, and national governments.

With respect to water access, the SAPCC highlights that present day demand for water is 1080 million gallons per day (MGD) which already outstrips existing supply at 880 MGD (2019). Key priorities of the action plan moving forward include increasing water use efficiency, expanding sanitation networks, enhancing water availability, reusing wastewater, and mandating water assessments and audits. The SAPCC also notes that there is an unequal distribution of water resources to residents which results in many communities relying on groundwater resources. Those resources only account for an 80 MGD supply, which is rapidly disappearing from overuse, development, and decreased aquifer recharge (SAPCC, 2019).

In Urban Droughts in India: Case Study of Delhi, the authors recommend: a revival of urban water bodies by increasing infiltration to allow for rainwater recharge, increased water distribution efficiency, increased research and collaboration between academics and government officials, greywater/rainwater harvesting, and demand side management instead

of supply side (Singh & Sharma, 2018). Demand side management is a technique commonly used in the utilities sector to encourage positive consumption reduction behaviors, instead of constantly looking for new resources. These recommendations are well suited to meet the water resource challenges noted in the SAPCC and are well aligned with the plan's key action plan to improve water access to Delhi's residents now and in the future.

While the SAPCC does acknowledge the problems faced by informal settlements and their particular vulnerabilities, there appears to be a significant gap in how the plan engages with these communities. For example, the SAPCC has estimated a budget of about US$820 million to carry out necessary water infrastructure upgrades. However, only a fraction of the budget is proposed to go to informal settlements and the plan contains no description of how the money would be spent (SAPCC, 2019).

To that end, our memo attempts to fill that gap by providing solutions for these informal settlements within Delhi to become resilient to the impacts of climate change. It is also worth noting the work of Sovacool et al. (2015), who highlight that there is a high danger of encouraging political, social and economic inequality with current climate adaptation projects. When studying the political economy of these projects, they state that there are four distinct processes that represent a struggle over power: enclosure, exclusion, encroachment, and entrenchment. Enclosure is the economic distribution of resources by transferring public assets to private hands, allowing them to be autonomous and risk the chance of creating their own bureaucracy. Exclusion refers to the political marginalization of stakeholders. Encroachment discusses damaging the environment/protected land that then encourages more greenhouse-gas emitting practices. Finally, entrenchment is the intentional worsening of inequality or disempowerment of women or minority groups. It is therefore incumbent upon policy makers to be cognizant of these social and political conflicts. Policy makers must continuously ask themselves: who is the adaptation for? Who stands to gain the most from the project implementation? How does an adaptation project promote or prohibit equity concerns?

PROPOSED SOLUTION

Rooted in our understanding that these marginalized informal settlements will be those most affected by climate change, our proposed solutions focus on building the capacity of these communities to be resilient in the face of disaster. Community-led capacity building can be fortified by small-scale projects through green infrastructure and improved monitoring of freshwater access in these communities. Insight from technical experts and outside actors, such as academics and international or local NGOs, would be integral in designing improved living conditions at the forefront of this plan. This project would focus on small scale investments inthe form of micro-grants from NGOs and analogous groups to communities as a means to build up living situations. Scale-up for sustainable change and overall resilience should be supplemented by long-term projects. This includes big projects led by the state and national government to improve freshwater access via grey infrastructure. Along with this, those living in these informal settlements must have a pathway to receive legal tenure of their property. As a result of the proposed community-led capacity building plans and the support of these institutional changes, we also anticipate these populations reinforce their ability to engage within the political action field. We propose that by empowering informal communities to increase climate resiliency, the entirety of Delhi benefits in mitigating the consequences of climate change.

Partnership with outside organizations can be an integral component of development for under-resourced communities. With discretion of the community, a partnership with outside actors could allow for additional information resources that can supplement current planning efforts by the Delhi government. A map of freshwater access, with particular attention to the access in informal settlements, would provide government agencies and NGOs the ability to formulate geographically precise urban action plans. A partnership with other outside organizations to receive insight from

technical experts could cut costs for the Delhi government and avoid political gridlock. In order to do this, compliance and some funding is needed by the Indian and Delhi governments. Continuous monitoring and evaluation of city-wide access to freshwater could be used as a metric for the effects of climate change in the city and report benefits from environmental policies enacted.

Green infrastructure initiatives that have already been implemented in formal communities can be expanded to informal settlements as well. It is estimated that through a city-wide scheme of capturing rainwater, 900 billion liters of water could be provided per day (SAPCC, 2019). The Delhi Jal Board (DJB) is the city entity responsible for the supply and distribution of water resources, and has requirements on all homes over 100 square meters to have rainwater harvesting systems to help ease the strain on water demand (Singh, 2019). The DJB recommends catchment systems such as underground storage tanks, but simpler, cheaper above-ground rainwater collection methods such as rainwater barrels or cement jars can be more easily installed in all different sorts of settlement types, including JJCs ("Harvesting System," n.d.). NGOs active in water issues in India such as WaterAid and FORCE Group's Blue India Program are ideal candidates to help spearhead this initiative for low-income communities and provide technical guidance ("FORCE," n.d.; "WaterAid India," n.d.). Both organizations monitor water access and sanitation in informal colonies and resettlement colonies, as well as provide water tankers with fresh water. Groups like FORCE and Mahila Housing Trust work to empower communities to build out more formal infrastructure without relying on the city directly ("Mahila," n.d.). They help communities organize leadership structure, determine their needs, and help organize finances. Additionally, green roofs are a solution that address both water and heat effects of climate change, keeping structures cool in hot weather, warm in cool weather, and reducing flooding during intense rain events ("Green Building Alliance," n.d.). Grass green roofs, the cheapest option with the lowest weight requirement, could be implemented on residential concrete or metal structures with the financing and technical expertise of local NGOs. Green roofs can also be scaled up to more formal, planned communities increasing their city-wide benefit as they directly tie into Delhi's SAPCC goals of greening the city, increasing biodiversity, and improving groundwater recharge.

Financing these projects will come in part from community microgrants. Organizations like Spark Microgrants provide a format that should be replicated in Delhi. The Spark format (referred to as "Spark's Facilitated Collective Action Process"), involves community engagement, setting clear project goals, project development, technical advice from an NGO, implementation, and a pivot towards the future. Spark acts as a facilitator in communities and helps find suitable NGO partners that can work directly with grant recipients. There are likely NGOs that can work directly with Delhi via a Spark format to implement green roofs and other infrastructure projects (i.e., the World Resources Institute).

TABLE 1

Proposed solutions to supplement community capacity building for climate change resilience

	Proposed Solution	Stakeholders/Drivers	Climate Challenges addressed
Immediate Term	Mapping of freshwater access within informal settlements	Federal and local government, academic institutions, NGOs	Droughts, heat waves
	Rainwater Harvesting	Community	Droughts
	Community Empowerment Microgrants	Federal and Local Government, NGOs, and Community	Building community capacity
	Community-Technical Partnerships	NGO and Community partnerships	Building community capacity
	Green Roofs	Community	Heat waves, flooding
Long Term	Grey Infrastructure for Stormwater and Sanitation	Partnership between federal and local governments	Flooding, heat waves, droughts, building community capacity
	Political Capacity Building	Unclear	Can be used to addressed climate problems more broadly
	Pathway to legal housing tenure for residents of JJ clusters	Federal and Local Government, NGOs, and Community	Flooding, heat waves, droughts, building community capacity

Despite the benefits of these community based initiatives, Delhi's climate resilience overall is dependent on the state's willingness to build grey infrastructure and formal housing in the long- run. In the interest of the state's investment capital, improving the resilience of water infrastructure has the potential net benefit of US$1.4 trillion (Global Commision on Adaptation, 2019). Improving the infrastructure for water sanitation would save India 5.2% of the nation's GDP (Lixil, Oxford Economics, & WaterAid, 2016, p. 8), therefore highlighting the state's cost benefit for heeding these upfront costs now for benefit in the future. Furthermore, the need for improved formal housing and legality for residents in JJCs is pivotal to the future of climate resilience. Inclusion of these residents would enable them to be more involved in the city economically, culturally, and politically - thus, improving the city's overall capability to holistically handle disasters caused by climate change.

By recognizing these necessary political actions, Delhi could be in a more capable position to be better protected financially and health wise. In times of climate emergencies and natural disasters, citizens in informal communities that are not resilient are completely reliant on government services. This poses major health risks and potential costs during times of crisis as Delhi's public services are stretched thin. Reaching the need for JJC residents and settlements similar to them allows the city to be better prepared in the face of disaster and protect the city from further consequence. Planning and protecting these informal settlements enables Delhi to be a technologically advanced city that can handle the inevitable repercussions of climate change.

CONCLUSION

Cities like Delhi are only as resilient as their least resilient citizens. This policy brief focused on ways to increase climate resiliency for those living in Delhi's informal communities, as formal climate plans from the city focus mainly on authorized communities. Because of the long standing tradition of ressetling colonies and pushing its citizens to the margins of society, community capacity building is likely the best method to increase climate resiliency in these communities when formal infrastructure is lacking. Proposed solutions will vary over the length of implementation and the types of settlements they can be implemented in due to the legal status of these settlements. However, since climate effects are already being recommended that actions begin now to prevent further future harm.

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APPENDIX

A.1 Categorization of Delhi informal and formal settlement types

	Settlement Type	Percent of Population[a]	Legal Status	Land Tenure	Infrastructure Access
Informal Settlement	**Jhuggi Jhopri Clusters**	14.8%	Illegal, highly vulnerable to evictions	On public land, no clear pathway to ownership	No infrastructure access
	Slum Designated Areas	19.1%	Legal, entitled to legal protections against eviction	Privately owned	No planned infrastructure, limited access
	Unauthorized Colonies	5.3%	Semi-legal, legalization in process	Mix of private ownership and public land	No planned infrastructure, limited access
	Rural Villages	5.3%	Legal, located in the city periphery	Private land	No planned infrastructure, limited access
	Urban Villages	6.4%	Rural villages absorbed by urban expansion	Private land	No planned infrastructure, limited access
Formal Settlement	**Jhuggi Jhopri Resettlement Colonies**	12.7%	Legal, established by government to resettle JJ residents	Publicly owned	Infrastructure planned but not implemented
	Regularized Unauthorized Colonies	12.7%	Legal, following completion of the "regularization" process	Mix of private ownership and public land	No planned infrastructure, some access
	Planned Colonies	23.7%	Legal settlement	Private land	Fully serviced by infrastructure

[a] Population estimates from Sheikh, S. & Banda, S. (2015). Categorisation of settlement in Delhi. *A report of the Cities of Delhi project, Centre for Policy Research, New Delhi.*

HELPFUL RESOURCES AND LINKS

Advancing Water Sustainability in Megacities
https://doi.org/10.3390/su11195314

Center for Science and Environment
http://www.rainwaterharvesting.org/urban/Practices-and-practitioners.htm
http://www.rainwaterharvesting.org/urban/Construction.htm
Rain water harvesting policy and practices in Delhi, construction of different rainwater collection structures

Delhi Shelter Board: Resettlement Policies
http://delhishelterboard.in/main/?page_id=2903

Delhi State Action Plan on Climate Change
http://moef.gov.in/division/environment- divisions/climate-changecc-2/state-action-plan-on-climate-change/

Demand for Rental Housing: Evidence from Slum Settlements in Delhi
https://journals.sagepub.com/doi/full/10.1177/2455747117700942
Paper outlining housing development policy in informal settlements

FORCE NGO
https://force.org.in/about-force/force-group-of-non-profits/
Clean water non-profit and community engagement

From Informal Settlements to Sustainable Communities
https://www.sciencedirect.com/science/article/pii/S111001681730279X
Paper highlighting the importance of community capacity building

Global Commission on Adaptation
https://gca.org/global-commission-on- adaptation/report

Mahila Housing Trust
https://www.mahilahousingtrust.org/
NGO performing community capacity building by empowering women to get involved with water and sanitation issues

Planning the Slum: JJC Resettlement in Delhi and the Case of Savda Ghevra
https://www.cprindia.org/research/reports/planning-slum-jjc-resettlement-delhi-and-case- savda-ghevra
A report outlining the infrastructural issues of the resettlement colonies

Slum Planning Schemes: A Statutory Framework for Establishing Secure Tenure and Improving Living Conditions in Indian Slums
https://journals.sagepub.com/doi/pdf/10.1177/097542531000200105
Importance and outline for increasing legal capacity for those living in unauthorized colonies

Types of Informal Delhi Settlements
https://www.cprindia.org/sites/default/files/policy- briefs/Categorisation-of-Settlement-in-Delhi.pdf

University of Chicago Professor Researching Quality of Life in Urban Slums
https://tcd.uchicago.edu/projects/quality-of-life-in-indias-slums/
https://www.law.uchicago.edu/faculty/malani

WaterAid India
https://www.wateraidindia.in/
https://www.wateraidindia.in/sites/g/files/jkxoof336/files/scaling-up-community- ownership-and-management-in-piped-water-supply.pdf
NGO providing water and sanitation in Delhi and rural India

HO CHI MINH CITY POLICY BRIEF

Prepared by: Matthew Boyle, Sanam Panjwani, Luis Mario Sosa-Lagunes, Rachel Steiner-Dillon, and Regina Harlig

EXECUTIVE SUMMARY

Ho Chi Minh City (HCMC), Vietnam faces significant challenges in the face of climate change. The city is experiencing severe flooding due to an increase in extreme rainfall events, as well as tidal flooding from the South China Sea (Tuan and Chau, 2018; World Bank, 2015). At the same time, HCMC's population is growing, with an influx of migration from other parts of Vietnam. These migrants are particularly vulnerable, as they often live in informal settlements (Truong et al., 2017). Decentralized planning and redundant government functions among city agencies and between the levels of city, district, and ward have made it difficult to address climate change efficiently (Canh *et al.*, 2013). In addition, the absence of private land rights in Vietnam has weakened the ability of HCMC residents to provide input in development decisions, limiting their participation in resilience-building efforts (Whong, 2019).

Two HCMC climate resiliency plans have been formally adopted since the year 2000. The first, developed by the Japanese International Cooperation Agency (JICA), was adopted in 2001 and primarily addressed drainage issues (Nguyen, 2018). The second was developed by Vietnam's Ministry of Agriculture and Development (MARD) in 2008, with the intent to control flooding (Vietnam Climate Adaptation PartnerShip (VCAPS) consortium, 2013). However, both have seen significant delays in implementation—a pattern that has plagued past infrastructure and development projects in HCMC (Clark, 2019).

In response to these challenges, we propose a suite of solutions to build resilience to climate change in HCMC:

a. **Streamline HCMC Government Functions:** City government agencies working on urban development must be better coordinated, and communication mechanisms must be developed to ensure that agencies are working together in order to build the resilience of HCMC's people and infrastructure. One entity that may be well-positioned to lead these efforts is the Steering Center of the Urban Flood Control Program.

b. **Establish a Regional Agency for Climate Adaptation:** The regional model of cooperation has been shown to be effective in U.S. states like Florida and California, where county governments have banded together to leverage resources (Hammett, 2016). As the hub of economic activity in Vietnam, HCMC would be well-suited to lead a regional agency, in partnership with the other six provinces that form the Southern Economic Region.

c. **Improve Community Engagement:** HCMC leadership must consider residents and implementing agencies as partners in the fight for climate resilience; without this, it risks furthering stalling climate adaptation efforts. The World Bank has had success implementing large infrastructure projects in Vietnam by integrating community engagement into the project design from the outset, and only moving said projects forward when they had gained significant resident support (World Bank Group, 2019).

1. BACKGROUND

Geography and Growth

Ho Chi Minh City (HCMC) is the most populous city in Vietnam; at approximately 8.6 million people, it represents 9.1 percent of the national population (General Statistics Office, 2020). After Hanoi, it is the second largest city by land area, at 2,061 km2 (General Statistics Office, 2020).

HCMC contains 19 urban districts and five predominantly rural suburban districts. The city's population has nearly doubled since 1995, and its urban expansion, as measured by urban land use and population, has been four percent per year (HCMC Statistics Office, 2016). HCMC and its surrounding provinces are considered the center of economic activity in Vietnam, as well as the country's manufacturing hub. The region was responsible for creating 32 percent of the national GDP in 2016 (Tractus, 2019).

Migration

HCMC has experienced an influx of migration in recent years. It reached its highest growth rate during the period 2004 – 2009, as rural migrants established industrial parks throughout the city and its surrounding provinces (Truong *et al.*, 2017). On average, the city absorbs 80,000 to 100,000 migrants annually, mainly consisting of workers enrolled in export-oriented labor-intensive industries. HCMC's migrants live in a precarious state, as they do not receive the same public services as other HCMC residents, and are excluded from the national household registration system (Truong et al., 2017). Migrants are also denied work in state administrative offices or departments.

2. CURRENT STATUS OF CLIMATE RESILIENCE

Flooding Challenge

There were 44 "extremely heavy" rainfall events (defined as more than 100mm of rainfall within three hours) in HCMC from 2001 to 2017. By comparison, there were only nine such events between 1962 and 2001(Tuan and Chau, 2018). Natural disasters that previously occurred an average of once every four years now occur on average three times per year. Just one extreme rain event can submerge major roads, flood neighborhoods with up to 60 cm of water, and take three hours to begin draining (Quynh, 2018). In addition to flooding caused by rainfall, HCMC also experiences tidal flooding, exacerbated by sea level rise (World Bank, 2015). In fact, new sea level rise projections show that during high tide, Southern Vietnam will be inundated and "could all but disappear" by 2050 (Lu and Flavelle, 2019).

Institutional Constraints

Unfortunately, HCMC's environmental problems are exacerbated by redundant and disorganized governance. The municipal government in HCMC is divided between the three levels of city, district and ward, each with its own people's councils, people's committees, and attending administrative agencies (Canh *et al.*, 2013). Responsibilities for each level have not been clearly defined, and often overlap. For example, district level institutions certify land use rights for households, but city level institutions certify land use rights for organizations (Canh *et al.*, 2013). HCMC has also greatly decentralized its planning authority, which has the potential to lead to confusion and mismanagement (Canh *et al.*, 2013).

Furthermore, HCMC authorities do not appear to have the institutional capacity to ensure that proposed developments are actually feasible. Numerous skyscrapers and privately financed developments that received approval from city authorities now stand incomplete after the original investors abandoned the project (Clark, 2019).

Land Ownership

Private land ownership is not well established in Vietnam, and all land is still considered to belong to the people, or more accurately the state (Embassy of Vietnam, n.d.). The absence of private land rights indirectly makes resilience more difficult by weakening the ability of residents to influence development decisions (Whong, 2019). Because of this, forced evictions are extremely common in HCMC and resident concerns are given little consideration in development projects (Duong, 2018). City residents have come to rely on persistent activism to resist development because official channels have proven inadequate (Do, 2018).

Current Climate Impact Mitigation Efforts

HCMC has adopted two plans since the turn of the century to address flood control and climate resilience. The first plan, developed by the Japanese International Cooperation Agency (JICA), was adopted in 2001 and primarily addressed drainage issues (Nguyen, 2018). The JICA plan was designed to guide HCMC through 2020. However, by 2018, the city had completed only 2,593 km of the 6,000 km of drainage channels called for in the plan (Quynh, 2018). The city has similarly underperformed in building planned wastewater management plants and flood retention ponds (Quynh, 2018). Today, even full implementation of the plan would not meet the city's needs, as its recommendations were made before the impacts of climate change were fully understood (Quynh, 2018).

HCMC's second plan was developed by Vietnam's Ministry of Agriculture and Development (MARD) plan in 2008, and was designed to control flooding (Vietnam Climate Adaptation PartnerShip (VCAPS) consortium, 2013). Though the plan has undergone several revisions, its core feature remains a massive dyke and sea wall (Quynh, 2018). In this instance, HCMC's slow and uncertain plan implementation may be a positive. Critics have highlighted significant risks in building the sea wall, including increased soil erosion, damage to ecologically important mangrove forests and worse flooding from rivers as access to the sea is reduced (Quynh, 2018).

Meanwhile, a dyke may actually be counterproductive in the long-term. The appearance of safety that dykes and seawalls create can delay a city's necessary adaptation to climate change through what is known as the "levee effect" (Ferdous *et al.* 2018). In some cases, the construction of flood barriers encourages more development that ignores the danger of flooding. The fate of New Orleans, Louisiana after Hurricane Katrina is a stark example of what happens when a physical flood barrier fails and a city itself is not designed to withstand flooding.

3. PROPOSED POLICY SOLUTIONS

a. Streamline HCMC Government Functions

As previously discussed, the HCMC government is not unified, which exacerbates the response period to the existing flooding problem. The current governing bodies are not well defined and duties are distributed between city, district and ward levels without clear demarcation. At each of these levels, there exist people's councils and committees which affect inter-level communication, coordination, and collaboration. Furthermore, no existing framework exists stating the protocols for communication between these different bodies. While the MARD has been focused on flood management since 2008, a lack of coordination between the MARD and other urban development agencies has the potential of disrupting implementation of resiliency-focused projects.

This system needs significant restructuring, with a new set of principles and values. It is necessary to organize the workflow and have a strict accountability system to ensure ongoing work is completed. Partnerships must be created between agencies to integrate service delivery and policy development. Existing roles should be redefined and government bodies should have a clear demarcation regarding work streams. These steps can help

maximize HCMC's existing capacity and reduce the operational and governance barriers that currently impede its effectiveness in implementing climate resiliency plans.

While it will be a difficult task, it is important for HCMC to begin by connecting relevant departments that have the power to alleviate this rising problem. One highlight in HCMC's planning history was the creation of the Steering Center of the Urban Flood Control Program (SCFC) in 2008. The SCFC was developed with an eye towards capacity building and institutional development (Vinke de Kruijf, de Boer and Tack, 2014). Ideally, this organization would become the sole, overarching authority on urban development in HCMC regarding flooding concerns. However, as of now, it remains one of several municipal level agencies with overlapping responsibilities. The SCFC would be able to realize its full potential as a center for flood control planning if there were fewer independent agencies with the power to undermine or contradict its plans.

Beyond the consolidation of department responsibilities, there is also a need for improved communication among the existing levels of governance. The establishment of a unified and standard communication mechanism, be it a chain of command structure between the levels of city government, or a system of regular reports between agencies, would provide increased coordination and subsequently, more effective implementation of plans and programs.

b. Establish a Regional Agency for Climate Adaptation

An under-explored response to climate change risks is to think beyond the city's jurisdiction to regional level collaborative solutions. Broader perspectives have been shown to help leverage resources, increase community resilience and incentivize engagement by different stakeholder groups, especially those historically absent from the decision-making process (Hammett, 2016).

The regional model of cooperation to address climate adaptation challenges is a recent phenomenon; however, there are some case studies that can serve as examples. For instance, the Southeast Florida Climate Compact is a regional- scale action collaboration which represents a formal agreement among different county governments to leverage funding and resources, forge partnerships throughout the region, and collectively address the impacts of climate change. Another case is California, which went a step further and created the Alliance of Regional Collaboratives for Climate Adaptation[1] (ARCCA) which provides support and guidance at the state level to local actors, and conveys local needs to the state government (Hammett, 2016).

In the case of HCMC, its strong economic position gives it the opportunity to develop a regional agency, which could include the six provinces that form part of the Southern Economic Region. This body could have direct communication with the national government and private sector. More importantly, having a regional institution would also allow better planning for the different provinces within the region, which could be a way to reverse the migration influx that has put pressure on the urban area of HCMC in the last years.

As a starting point, it is important to consider three main questions:

1. What functions and roles would this institution have?
2. Which stakeholders should be represented?
3. What criteria should be used for decision making?

In terms of government functions, this agency should be able to design a regional climate policy framework, regulate performance in key sectors (e.g., urban planning within the city, or natural barriers to reduce the risk

1 A comprehensive list of the different Regional Agencies for the state of California can be found in: https://www.ca-ilg.org/post/regional-collaborations-adaptation

of floods along the river at the provincial level), and provide incentives, funding and authorization to enable action at the provincial level. To be successful, it should include stakeholder groups historically omitted from the decision-making process, such as the residents of informal settlements and rural areas; and finally, this agency should adopt a mix of funding and human capital focused on

c. Improve Community Engagement

HCMC has struggled to implement past plans for water management and flood mitigation in large part due to failures of stakeholder engagement. The 2001 JICA drainage plan, only 43 percent complete after 17 years despite broad support, faced ongoing setbacks because the agencies responsible for implementing the plan's various projects lacked the experience and expertise necessary to carry them out (Ho, Hermans, and Gerardo, 2015). The 2008 MARD flood mitigation plan was developed without community input, and sparked considerable controversy over sustainability, operation, cost-benefit, and navigation of affected rivers. As a result, the plan was never implemented, and a revised plan developed in 2012 was never even approved (Ho, Hermans, and Gerardo, 2015). HCMC's leaders have shown a willingness and ability to identify the threats posed by climate change and develop plans to address them. However, unless it improves stakeholder engagement in its planning processes, the city is likely to continue to face difficulties with implementation.

Policy makers in HCMC should draw on existing best practices for community engagement for all future plans. The World Bank has developed a comprehensive framework for community engagement, with specific tactical suggestions that have proven successful in development projects across the globe (Manroth et al., 2014). The key to this success is empowering residents to be involved in their own solutions, and ensuring that implementation plans consider both the social and technical feasibility of the project. The World Bank has successfully implemented large infrastructure projects in Vietnam by integrating community engagement into the project design from the beginning, including not only public hearings, but focus group discussions, surveys, and participatory planning. These projects moved forward only when they had gained significant resident support (World Bank Group, 2019). The International Association for Public Participation identified a Spectrum of Community Engagement including efforts that allow stakeholders greater or lesser impact on decision making (International Association for Public Participation, 2018).

While no single step on the spectrum is appropriate for every situation, HCMC leadership might consider opportunities to consult with city residents about their needs, involve stakeholders who will be essential to implementation in the planning phases of new projects, and/or include community leaders as key collaborators in developing new solutions to ongoing challenges. By considering residents and implementing agencies as partners in the fight for climate resilience, HCMC will greatly improve its ability to see its plans carried out.

4. CONCLUSION

As both climate change and urbanization accelerate, cities around the world will need to act quickly to protect their land, infrastructure, and residents. Given its coastal location, low-lying topography, and the increased frequency of heavy rain events, Ho Chi Minh City is especially vulnerable to climate change; it is clear that the HCMC government must be better prepared to adapt to climate change. Past efforts to address climate change and improve urban development in HCMC have stalled, but by streamlining city government functions, establishing a regional climate agency, and improving stakeholder engagement methods, the city will be better positioned to increase its resilience to climate change.

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JAKARTA POLICY BRIEF

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EXECUTIVE SUMMARY

Jakarta is the world's second most populated metropolitan area and perhaps the megacity most threatened by climate change. Rising seas, overflowing rivers and sinking ground beneath the city cumulatively have led to floods that have displaced tens of thousands of people and could make large swaths of the city uninhabitable. While there are ongoing and anticipated programs meant to address the challenge Jakarta is facing, much more must be done. Through increasing the area's water absorption capacity, there should be a significant decrease in the amount of flooding the area sees. To achieve this end, we have two recommendations: 1) Augmenting existing relocation programs to remove at-risk populations from flood prone areas to encourage autonomous relocation, and 2) conducting a study to investigate the feasibility of expanding the area's rivers beyond historical capacity.

BACKGROUND

Indonesia's capital city Jakarta is in the world's second most populous urban area, home to more than 33 million people. The seaside city is the financial center and economic hub of the archipelago nation. Yet, in the near future, flooding provoked by climate change and other human activities is likely to displace millions of Jakarta's residents and could threaten the very existence of the low-lying metropolis. Nowhere does such a densely populated area face such an existential threat.

Jakarta faces three dire threats: its coastal areas are increasingly being flooded by rising seas, its inland areas are increasingly being flooded by congested rivers, and the city itself is sinking at a rate of between 5 and 25 centimeters per year in some districts (Abidin et al. 2015). The flooding has caused massive displacement and economic losses in recent years. In the first two months of 2020, flooding in the city killed 66 people and dislocated 400,000 residents. Floods in 2003 and 2007 caused a combined $1.8 billion in economic damages and losses (Akmalah and Grigg 2011).

Jakarta is located on the northwest coast of the island Java, sandwiched between the Indian Ocean and the Java Sea. It sits only a few meters above sea level in some districts, while other parts of the city are below sea level. As climate change induces sea level rise in the coming decades, it will put Jakarta in a precarious position. Over the past few decades, portions of the city's coastline have decayed by as much as four meters, and in some locations, concrete barricades are all that separates densely populated areas from the sea (Guest 2019).

Thirteen rivers snake through inland Jakarta. As the city has grown and become more developed, these waterways have been choked by human waste and debris (Rahayu et al. 2019). Urban development and informal settlements along riverbanks and floodplains have reduced the capacity of the rivers, causing them to flood more frequently in increasingly populated areas (Simarmata 2019). At the same time, climate change has induced higher rainfall in Indonesia, further straining the constricted waterways (Simarmata 2019).

Jakarta sits atop an underground aquifer from which the city pulls its water. As the city's population has swelled, overuse of this resource has caused Jakarta to sink rapidly. Almost 40% of the metropolis now lies below sea level, and at the current rate, nearly all of North Jakarta will be below sea level or submerged sometime between 2030 and 2050 (Lin and Hidayat 2018).

Jakarta's poorest areas are informal settlements frequently located in low-lying areas more prone to flooding. That includes hundreds of thousands of people living in floodplains identified as valuable geographic locations for increasing river capacity and reducing flooding (Rahayu et al. 2019). The Greater Jakarta Area comprises seven cities across three provincies. Jakarta city proper, with 9.7 million inhabitants, is its own province with one governor and five mayors.

Indonesia's national capital functions are set to move from Jakarta in 2024, a change that is estimated to cause 1 million people to relocate from the megacity over time (Sari 2019).

CURRENT STATUS OF CLIMATE RESILIENCE

Resiliency efforts undertaken by Jakarta's provincial government, referred to as the DKI administration, fall primarily into two categories: infrastructure and social.

Infrastructure

Indonesia's 2007 Spatial Planning Act is essential to increasing water capacity by requiring all urban areas to set aside 30% of the city land for green space, such as city parks, cemeteries, and green roads (Ministry of Land, Infrastructure, Transport and Tourism, Japan, 2019). In Jakarta, currently only 10% of the city is green open space, according to an analysis by the United Nations Research Institute for Social Development (UNRISD), suggesting a lack of enforcement for national spatial planning laws at the city level (2019).

The UNRISD report reveals that the DKI administration has adopted several water engineering measures to improve the city's hydrological system, mainly via large infrastructure projects. Projects to prevent river flooding include dredging, widening, and embanking Jakarta's 13 rivers to increase their capacity during peak rainfall. These activities are called "river normalization" (the process of restoring the river to its original width and depth, undoing decades of human activity in which settlements cropped up along riverbanks and waste accumulated inside riverbeds). Funded by both the provincial budget and the World Bank, the National Public Works and Housing Ministry is overseeing the projects. The DKI Government also has ramped up its spatial law enforcement with color-coded supervisory squads known as rainbow teams (*Pasukan Pelangi/Warna-warni*). As detailed by the UNRISD report, blue team members deal with flooding by clearing drainage systems from litter or pump water out of puddles, green team members plant trees in parks and clean public parks from litter, and orange team members sweep and mop public spaces such as streets, pavements, and transit stations. These local response teams successfully have reduced the volume of waste and mud blocking the natural flow of the region's rivers and have helped increase the city's total drainage capacity. Maintaining these efforts is crucial, as floods increasingly threaten essential structures such as schools, hospitals and airports, as well as low-lying housing and kampungs. These rainbow teams have helped improve enforcement of zoning laws, but implementation in other fields, such as building codes, remains largely unaddressed.

Jakarta's most substantial infrastructure response to climate change is the $40 billion National Capital Integrated Coastal Development (NCICD), which includes the development of a water reservoir, reclamation of land, and construction of a seawall along the coast (The Giant Swa Wall of Jakarta), designed to protect the mainland from tidal flooding (The Guardian, 2016). The project began construction in 2014 and is slated for completion in 2025. It is funded with aid from the Dutch government and the participation of a slate of Dutch engineering companies to be completed in three distinct phases. However, the seawall's projected completion date has been delayed from 2020

to 2022 due to stalled negotiations, as the DKI administration is still negotiating with the national Public Works and Public Housing Ministry about which projects will be led by which government bodies (Rahadryan, 2019). These initial infrastructure solutions also cannot completely mitigate the damage set to be caused by climate change: while the danger from rising sea levels can be alleviated by seawalls, river flooding remains a perennial problem.

A project to normalize the Ciliwung River by procuring 118 plots of river-adjacent land and building embankments was abandoned in late 2019 but then reinitiated in January by President Widodo. While the Public Works and Housing Ministry's Ciliwung-Cisadane Flood Control Office was tasked with carrying out the project, they did not receive profit-sharing funds from the central government and disagreed with the Jakarta Governor about whether the scope of work would include river naturalization. In sum, the execution of infrastructural projects for flood mitigation have been marred with uncertainty and risk becoming inadequate even before they are finished. The decentralized nature of Jakarta province's flood-mitigation efforts has complicated project completion by causing "un-integrated urban-rural spatial planning within the watershed" (Asdak et al, 2018; Voorst 2016).

Social

Jakarta has constructed public housing away from riverbanks to incentivize residents of *kampungs* built in areas zoned for blue space to relocate (UNRISD). Past administrations have paired relocation efforts with educational programs that used workshops and print materials to explain to residents how proper household waste management is crucial to flood mitigation (Pahrevi, 2020). Critics, however, argue that social policies often have been overlooked when designing large-scale infrastructure projects (Simarmata, 2019; Dovey, 2019). For example, the NCICD seawall megaproject failed to include environmental impact assessments that addressed how the livelihood of local fishermen might be impacted (Nurhidayah, 2019).

For natural disasters such as tsunamis and earthquakes, the national Indonesian government has implemented a community-based relocation program known as REKOMPAK, in which relocated residents "leverage their social networks to make all necessary decisions including: i) member assistance eligibility, ii) community site layout, iii) housing design, iv) necessary infrastructure, v) neighborhood construction, and vi) long-term housing and infrastructure maintenance," a model which minimized "social disruption that these residents experienced [and leading] to higher levels of satisfaction following relocation" (Iuchi & Mutter, 2020). Our analysis of online research journal databases, World Bank project databases, and online news searches in both English and Indonesian returned no evidence that the REKOMPAK model has been used for relocation of populations in fluvial flood-prone areas in Jakarta.

Climate-resilient megaprojects are inherently slow-moving. For Jakarta, this means there is opportunity for policymakers to focus on smaller projects that can: 1) more quickly decrease risk of morbidity and mortality related to river flooding and 2) make it more likely large infrastructure projects reduce flooding in the long-run. Proposals in the next section focus on government programs that incentivize community-based relocation of people living in flood- prone areas to increase blue and green space.

PROPOSED POLICY SOLUTIONS

1. Augment existing relocation programs by instituting economic and social incentives to spur autonomous relocation to desired areas.

Relocation of communities living in flood-prone areas helps increase urban blue and green space for absorption capacity. Relocation efforts also support public safety by reducing risk of drowning, electrocution, and other morbidity and mortality risks linked to flooding. Current relocation programs have been implemented in various ways over the past decade in Jakarta, oftentimes relying on the forced removal of individuals in those communities

(Dovey et al, 2019). Our recommendation is that existing programs be augmented with economic and social incentives to encourage communities to relocate proactively and autonomously.

For these incentives to be effective, it is imperative to increase communication with the families and communities living in river-adjacent and flood-prone areas to convey the benefit of moving out of their current area to safer zones. This engagement should not be directed toward individual families but rather be implemented at the community level. Encouraging communities to relocate together based on ethnolinguistic groups, employment types, and geographical proximity could help encourage movement and protect against communal social benefits being lost in the process (UNHCR). In addition, relocating based on community rather than family-by-family makes communication to the entire population simpler, as social infrastructure and networks would be less disturbed. We recommend relocation plans to use the REKOMPAK model as described by Iuchi and Mutter (2020) we outlined in the previous section.

Economic incentives are imperative for autonomous relocation to be effective. By relocating, individuals could be risking their livelihoods, particularly if their employment is location- dependent, such as with landlords or fisherman. To ensure those populations feel comfortable moving to safer regions, economic opportunity must be available in the new areas (Peng, 2020). Current incentives, such as rent stipends, are relatively unsustainable if employment and economic opportunities are scarce in the new areas. Spurring economic development in the new zones and encouraging businesses in flood-prone regions to relocate will help displaced people to afford to live in resettled areas rather than return to informal housing. However, it is not realistic to presume every resettled individual will be able to find work in these new communities. Therefore, relocation programs should coordinate with Jakarta's ongoing transportation expansion to ensure relocated people have access to economic opportunities across the entire region.

2. Initiate a study to assess the potential for river expansion past historic levels

Jakarta is particularly susceptible to flooding when the rivers that flow through the city overflow during heavy rainfall. The resulting damage is exacerbated because the polluted rivers have become less absorptive and because dense settlements, such as kampungs, built in low-lying areas have left less space for additional flood control infrastructure.

We recommend that the National Ministry of Public Works and Housing, already engaged in river expansion efforts, perform a study to assess the potential for river expansion past historic levels. By increasing the absorptive capacity of these rivers, the waterways can function as sinks during periods of excessive rainfall and flooding, and as sources of water during Jakarta's droughts. Normalization involves interventions such as promoting reforestation along the riverbanks, widening the river, using infiltration wells and developing flood-plain zones to restore the river's original absorptive capacity and flow level.

While the DKI Government already has identified river and drainage normalization as a significant countermeasure against flooding, it is necessary to study the potential for rapidly increasing the absorptive capacity of these rivers. The process is capital intensive and, as discussed in our first recommendation, requires relocating people and infrastructure currently situated along the riverbanks. Furthermore, river normalization must be supported by auxiliary efforts, such as removing the waste from waterways to improve flow and reinforcing high- pressure portions of the rivers. To date, the government has not yet developed a comprehensive and evidence-based implementation plan that accounts for all these factors.

A study could help disclose the precise scope of this intervention, which could in turn help garner support across government bodies and functions. As recent efforts to normalize the Ciliwung River show, it is critical to these efforts to have a high level of coordination among various government organizations. In that aim, each participating organization must have a clearly defined role, mandate, and requirement for transparency at each stage of the project (this includes funding, designing and implementing the normalization plans). Currently, division of responsibilities

is muddled, and in some cases, roles are shared under the ambit of multiple government offices. By clearly defining all the work streams required, the central coordinating body more easily can segment, designate and distribute responsibilities among key offices.

Therefore, in order to increase the effectiveness of river normalization efforts, improve the clarity of what actions are necessary towards this and align various government offices, a comprehensive study must be undertaken in Jakarta. Key aspects of the study include understanding the potential applicability of river normalization beyond historic levels (especially considering the threat of coastal flooding), identifying phased implementation plans that include the normalization of all possible water bodies, and conducting a thorough cost-benefit analysis of each stage.

CONCLUSION

Flooding in Jakarta poses an existential threat to the city, requiring leaders to adopt a rapid, multifaceted approach to mitigate harms caused by climate change and land subsidence. By engineering river-adjacent landscapes capable of better absorbing and channeling rainwater, Jakarta can become a more resilient and inhabitable city. Still, to implement this solution, hundreds of thousands of people must relocate from precariously situated homes – an effort that will allow them to proactively protect the wellbeing of their community while also benefiting the city at large. Introducing voluntary incentives to incite this move would be infinitely preferable to mandatory eviction efforts; and formulating a relocation program that accounts for employment opportunities, cultural values, and public transportation issues could create a policy blueprint that proves useful if a greater portion of the city's population faces flooding displacement in the coming decades. These policy solutions represent a narrow but critical step that must be taken to ensure Jakarta has a viable future.

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ADDRESSING CLIMATE ADAPTATION FOR WATERFRONT COMMUNITIES IN LAGOS, NIGERIA THROUGH IMPROVED LAND TENURE AND ACCESS TO BASIC SERVICES

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EXECUTIVE SUMMARY

Lagos, Nigeria is being challenged by sea-level rise, coastal flooding, and other impacts from climate change that are altering demographic and settlement patterns in Sub - Saharan Africa's most populous city. Combined with current development paradigms and infrastructure concerns, climate change is creating dynamic risks for the city, with increased in-migration and internal displacement that are forcing a swelling population to settle in already vulnerable coastal zones. This memo outlines an incentive-based relocation pilot and evaluation template that incorporates input from local stakeholders, including the city government, and salient NGOs, to develop a program that:

- Mitigates long-term threats to vulnerable coastal communities by promoting settlement in more sustainable locations.
- Accounts for legitimate local needs, setting up communities that offer secure housing, access to health facilities, and other basic services that are currently unmet.
- Establishes a robust data-collection program so that the city can effectively monitor progress in communities.
- Facilitates access to long-term legal tenure to protect communities in the long run.
- Serves as a globally replicable model that can be altered to meet the needs of distinct communities with different local realities.

I. RELEVANT BACKGROUND INFORMATION

Lagos, Nigeria is Sub-Saharan Africa's largest city, with a current population of over 18 million that is expected to swell to 25 million by 2025 (Elias and Omojola, 2015). Given its size, Lagos is the demographic and economic center of Nigeria, home to 65 percent of the country's industrial activities, over 65 percent of commercial activities and a majority of non-oil economic activity (Adelekan, 2010).

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The people and the economy are both challenged by climate change due to the city's coastal location and demographic trends. Lagos' location in a low-lying delta makes it vulnerable to sea level rise and seasonal flooding (Haider, 2019). The city's critical infrastructure, including its extensive road network and its utility assets, has struggled to adapt to such changes (Elias and Omojola, 2015). Correspondingly, residents and the local economy have been adversely impacted and endangered by substandard infrastructure.

These environmental changes have disproportionate impacts for the city's most vulnerable who live closest to the coastline (Adelekan, 2010). Currently, nearly two thirds of Lagos' residents live in informal settlements, particularly in low-lying delta regions (Ajibade et al., 2016), which are referred to as "waterfront informal communities" throughout the report. These high- density settlements face the worst effects of environmental degradation and lack basic water, sanitation, electricity, and other essential services (Adelekan, 2010). Additionally, these residents lack legal tenure and face the threat of forced eviction by the state. In response, grassroots NGOs, like Justice & Empowerment Initiatives, operate to advocate for basic rights and dignity and against forced evictions.

These aforementioned conditions will be exacerbated by climate change. Notably, the increasing incidence of droughts in the country's northern agricultural regions have pushed migrants to Lagos in search of economic opportunities (Haider, 2019). While rising sea levels are a long- term threat, increasing migration due to ethnic conflict in Northern Nigeria aggravated by drought conditions is a short-term reality. As climate impacts become more acute, it is likely that Lagos' waterfront informal settlements will face increased risk. Compounding climate impacts that are spurring increased in-migration to low-lying communities that are proximate to the port economy, increased flooding and sea-water ingress in these areas, a lack of financial opportunities available to day-wage workers and an absence of a state-level adaptation plan make Lagos' waterfront informal communities highly vulnerable.

II. CURRENT STATUS OF CLIMATE RESILIENCE

To address the city's climate risk, the Lagos Minister of Environment published their "Towards a Lagos State Climate Change Adaptation Strategy" as part of the Building Nigeria's Response to Climate Change (BNRCC) Project in January 2012. The strategy aligns current policies and existing initiatives to support climate adaptation and lays out the city's current strategy to deal with climate change. It notably includes institutional measures like the new Water Supply and Sanitation Policy that aims to facilitate climate change adaptation for water access and water security. Despite recognition of climate risk in the BNRCC report, there are significant existing gaps in Lagos' formal climate adaptation plans. The Lagos State Emergency Management Authority (LASEMA), established to coordinate emergency and disaster management, is poorly funded and ill-equipped to deal with the increasingly frequent and severe disasters that it manages (BNRCC, 2012). Additionally, there are limited measures in place to protect the economic institutions of Lagos (BNRCC, 2012). The BNRCC report highlights that the city's utilities, including its electricity and water distribution services, will also need specific funds to safeguard operations (BCNRS, 2010).

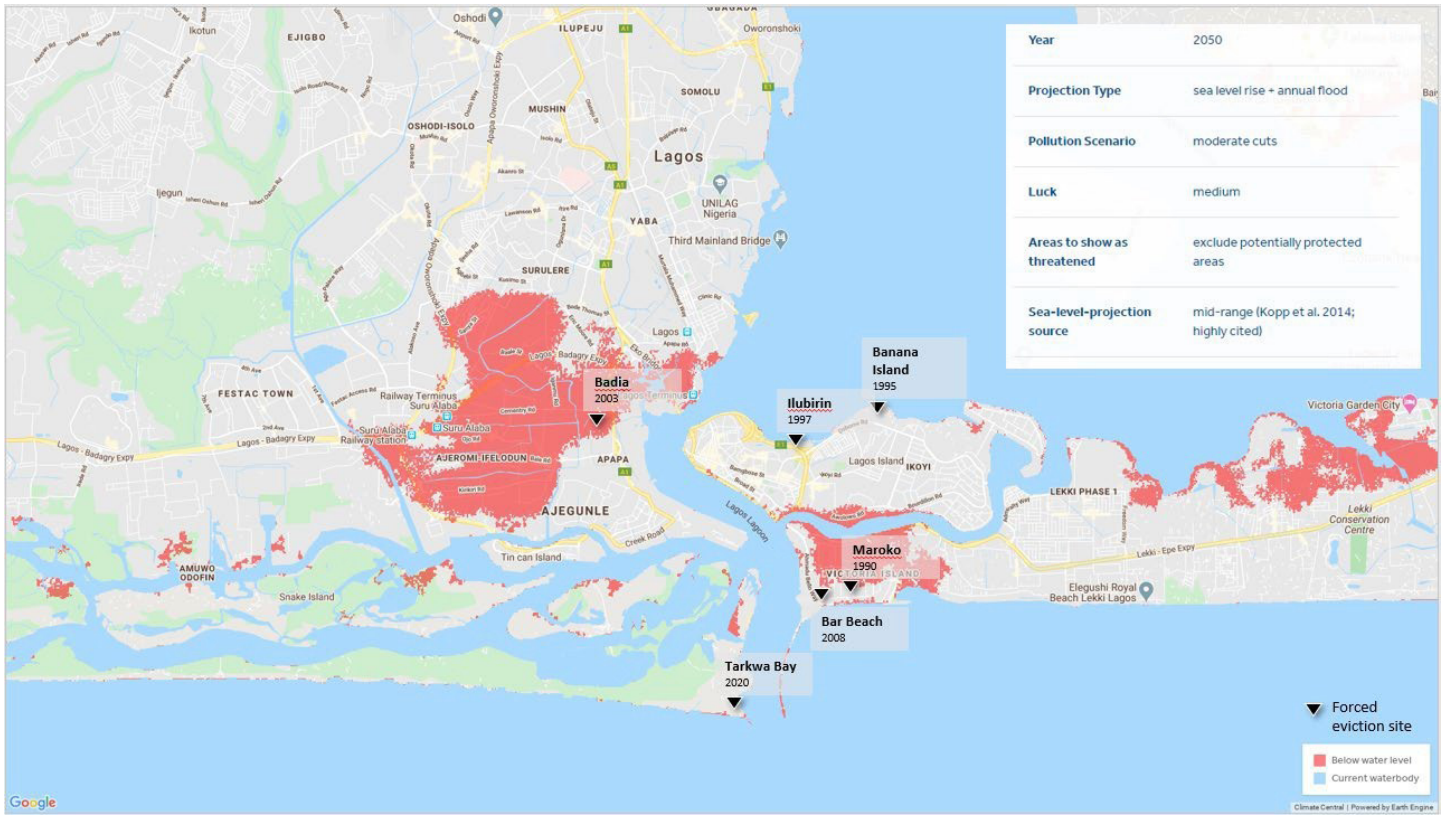
Importantly, many of the current adaptation and financial plans have been geared towards protecting high-income communities and ensuring that these residents have their housing rights protected (Ajibade, 2014). By contrast, low-income and informal communities have traditionally lacked formal protections from the government, often resulting in increasing marginalization of already vulnerable populations.

In this context, it is important to recognise that the Lagos State Government has had a tumultuous history with relocation and displacement of informal communities. Forceful evictions have resulted in the loss of lives, displacement of vulnerable communities, and mistrust of government. Figure 1 shows that some of the most significant forced evictions in the last two decades have taken place in informal waterfront communities. While some clearances were for the Lagos Metropolitan Development and Governance Project, such as those experienced by residents in Badia (Bugalski, 2016), others have been motivated by massive real estate investments along the

waterfront (Kazeem, 2020). The most recent forceful eviction took place in January of 2020, which removed 4,500 people from the Tarkwa Bay community to make way for the development of a new tourist hotspot. While the Lagos State Government has demonstrated its intent to invest in these locations, its motivation has been driven by short- term economic gain, sinking capital investment funds into infrastructure that will be rendered obsolete by the increasing risk of sea level rise in these locations (See the red zones in Figure 1 below). Moreover, the Lagos State Government does not take cognisance of the informal communities, who are the natural residents of these lands, and it does not take an active role in supporting livable housing or relocating these informal communities (Ajibade et al., 2016). Appendix II documents the magnitude of historical evictions as an estimate of the social cost of these actions.

FIGURE 1

Image compiled from maps on Climate Central (Kopp, et al., 2014) and Open Street Maps[6]



Our adaptation program acknowledges the risk of community unrest and resistance in the face of any state - led intervention. Notwithstanding the history of government being perceived as a bad actor, we incorporate learnings from participatory governance-based relocations of informal settlements in Nairobi, Kenya and Cape Town, South Africa. These initiatives demonstrate the power of community organizing in fruitful negotiations with partners, such as government agencies, research institutions, and funding bodies, including the World Bank and private foundations.

Nairobi's history with forced evictions and widespread informal housing is similar to those in Lagos. Here, the Kenya Federation of Slum Dwellers, Muungano wa Wanavijiji, used community-driven processes to facilitate the successful relocation of one of Nairobi's largest informal settlements along Kiberia's railway line. The project was financed by the

6 This image is generated manually from the maps cited because of proprietary restrictions on access to the underlying spatial data. With access to this data, a more accurate visualization can be produced.

World Bank through the Kenyan government. Muungano leveraged its existing community-based savings groups where actual beneficiaries of the project pooled their savings together to manage procurement expenses and to buy equity in the relocated land. Housing plans and designs were developed based on demographic data collected by the community itself. 10,000 houses were constructed along the railway line in a manner that secured the railway land and avoided future encroachment. This co-produced solution housed participating households on a smaller footprint of land, clearing out the railway reserve lands and also upgrading living conditions for erstwhile informal dwellers (Mbaka, 2015).

Similar projects have since been executed in Mukuru, Kenya (Weru, 2017) and Cape Town (Hendler, 2015). See Appendix III for a detailed description of participatory governance processes. While the processes of co - production have strengthened the community voice, these projects were in the development phase for 5 - 10 years before breaking ground on greenfield locations, indicating the risk of extended timelines due to uncertainties in stakeholder priorities, especially funders and governments.

III. PROPOSED POLICY SOLUTIONS

Our proposal is the initiation of a relocation program for informal settlements in and around the vicinity of Lagos' waterfront co-produced by communities and government bodies. The program is envisaged to result in new community spaces or neighborhoods expanding northwards and westwards from the Lagos city center over the next 10 - 15 years. Consequently, the waterfront lands will be restored to their natural wetland condition to serve as buffer spaces to counter sea ingress. As mentioned in Section II above, the Lagos State Government has made increasingly risky capital investments in the waterfront area to encourage short-term economic growth without supporting relocation of evicted communities. The relative distance and invisibility from State mechanisms are a pull factor for newly displaced migrants from northern Nigeria, who come to these communities to escape drought and conflict. In the status quo, these communities are locked into living conditions that will worsen as a result of densification, frequent flooding, and a decrease in availability of basic services. Residents are further impacted by poor health and economic outcomes, further increasing vulnerability and costs of inaction over time (Sayne, 2011).

These conditions call for adaptation interventions that address the existential threat that these communities face. Conventional adaptation measures involve investment in infrastructure improvements in situ, such as sea walls, dykes and reinforced embankments. However, these communities inhabit marginal lands with little or no formal infrastructure or legal tenure and a complete upgrading to resilient infrastructure on the waterfront requires the additional costs of land improvements and tenure reform. Due to these high costs, relocating impacted communities to greenfield locations in northern and western hinterlands in Lagos, where they are provided with upgraded legal housing, would be a more cost-effective option than the technical and social costs of in situ adaptation measures, drawing from lessons from other successful programs in Kenya and South Africa. However, building consensus on the urgency of responding to impacts of climate risk is a challenge because residents in these marginal lands are already faced with a significant level of physical risks including flooding, fires, and disease due to insufficient drainage, insulation and proximity to waste. While this relocation program is designed with the intent of addressing the long-term threat of sea level rise to waterfront informal communities, an incentive structure that capitalises primarily on meeting immediate community needs, such as legal tenure and improved water and sanitation through relocation, would have significantly higher impact. Given the absence of declared financial intent to invest in these communities from Lagos State Urban Renewal Authority (LASURA), the provision of land and basic services to greenfield developments requires incentives to align for the urban authority as well. The recent election of a new Governor of Lagos and a declared mandate from the Mayor's office as a member of the C40 alliance of cities is an opportunity for community organizations to advocate the allocation of land from the city in return for support from funds dedicated to climate change adaptation from the Green Climate Fund, the UNFCCC Adaptation Fund, or similar mechanisms.

The availability of climate adaptation funds from international agencies enables the creation of an incentive structure that favors relocation programs to support vulnerable waterfront communities into legal and safe housing with buy - in from LASURA. The success of this policy proposal is incumbent upon managing power dynamics between the various stakeholders needed to implement this program. Informal communities currently hold very little power in their relationship with urban authorities mostly because of the "illegality" of their settlements and a deep mistrust of government action in these communities. Notwithstanding this dynamic, our program requires urban authorities to allocate land in negotiation with communities to create a voluntary and collective move away from vulnerable locations.

There is evidence to suggest that LASURA would be willing to pay a subsidy to informal residents under certain circumstances. In 2018, LASURA piloted an incentive structure to relocate families to a redevelopment of Adeniji Adele Phase 1 Housing Estate on Lagos Island with options to move to the Agency's Transit Camp or get paid to secure a convenient accommodation in a location of their choice pending the completion of the project. Twelve families were selected to receive N500,000 to rent an apartment of their choice in a preferred location. As a naive estimate, this converts to $1,355 USD. Accounting for inflation, LASURA has demonstrated a willingness to offer a household approximately $1,384 to relocate in 2020. As demonstrated in relocation projects of similar complexity in Nairobi and Cape Town (see Section II), these NGOs play a pivotal role in negotiating a fair agreement between the government and the communities, especially to address an inherent distrust stemming from a history of forced evictions. However, facilitation by NGO groups is not a complete addressal of the fact that, without building equity for residents themselves, this might worsen the social vulnerability of residents who choose to move. To address this, we also built into our program the idea of co - produced communities where relocating residents would undertake construction at site, using skills transferable from manufacturing and dockworking service jobs.

However, even when all the incentives align, there are uncertainties that could confound the level of impact realized. The target population is more than a million people and increasing, given Lagos' high population growth rate, as discussed in Section I. Constraints on institutional capacity, availability of safe greenfield land and accessible financing place limits on the size of the program. Given that these communities are invisible in formal government records, there is also inadequate data on demographic profiles necessary to prepare implementation plans. Moreover, building consensus at this magnitude with government and community stakeholders that do not share a prior record of cooperation also extends timelines, with significant effort - spend on building trust and accountability. There is evidence of this from challenges being faced in relocation programs of this scale in Kibera, Kenya and Vusi Ntuntsha in Cape Town (See Section II).

We propose to start with a pilot program by selecting three communities to work with and relocate over a three-year time horizon. This pilot will be community-driven, led, and implemented. Learning from best practices in other relocation programs, we recommend that this pilot be facilitated by community-based NGOs, like Justice & Empowerment Initiatives, who are trusted allies of waterfront communities in Lagos for their legal support to the fight against forced evictions[7]. The operating NGO will lead the identification of waterfront communities to participate in the pilot program and collaborate with LASURA to identify greenfield spaces for housing development to resettle households that opt - in. A key demand in negotiations with the government should be the acquisition of legal rights to households opting into the program and the formalization of a five - year subsidy program for informal households and new migrants who relocate to the new location. The expected outcomes from the pilot program are a demonstration of the incentive mechanism and improved trust between the government and resettled communities. Table 1 summarizes our proposed action plan for the pilot program.

7 For more information, please see: JEI, *Justice & Empowerment Initiatives,* www.justempower.org/.

TABLE 1

ITEM	DESCRIPTION	ACCOUNTABILITY
Community profiling of all waterfront communities	• Household level socioeconomic survey • Location • Level of emergencies	Co-produced by community and partner NGO
Selection of communities for pilot	• Negotiation and consultation based on scale and preference for relocation	Partner NGO and communities
Land allocation and property rights	• Greenfield location for relocation housing project in consultation with community; • Formalization of legal tenure	LASURA; Facilitated by partner NGO
Technical Design and Review	• Housing site plans, cost estimation and materials procurement • Negotiate subsidy scheme with LASURA	Partner NGO; In consultation with community
Construction and relocation	• Training and deployment of benefitting household adult members in construction and procurement • Relocation to new location	Partner NGO; In consultation with community
Monitoring and Evaluation	• Percentage of funding from government and private/intergovernmental actors • Take - up/response from community • Public health indicators • Evidence of policy shifts in LASURA	Partner NGO

Monitoring and evaluation of the pilot program will touch upon the level of government financing, private funding, number of households served, and improvement in public health of community members. We envisage that the lessons learned from this pilot will help to scale up the program in staggered steps over the medium-term to all waterfront communities. In the next 10 to 15 years, we expect to relocate a greater majority of communities away from low- lying waterfront lands in Lagos, which will be returned to natural conditions with native plant species such as mangroves to serve as a further disincentive for new human settlement. Funds for wetland restoration will be identified after the successful implementation of relocation.

IV. CONCLUSION

Lagos offers a lens into how the world's growing megacities are being challenged by climate change and the ways in which rapidly expanding cities will need to account for quickly changing population dynamics. While coastal cities will no doubt need significant physical infrastructure upgrades, adaptation measures will necessarily need to be holistic in scope rather than just seawalls and dikes. More to the point, given even the most conservative climate

impacts, there will be regions within cities that will become inhospitable. Because current inequities will likely unequally impact those that are currently the most disadvantaged within Lagos, the government will be challenged to incentivize its citizens to inhabit lands that face fewer threats. Thus, the incentive structure proposed here has global applications and offers a phased program template for adaptation through relocation that may apply to cities with informal settlements, agnostic of the specific nature of climate challenges. Notably, the very nature of the proposed program template, which relies on input from key local groups including impacted communities, NGOs, government as well as cooperation with international players like the World Bank, makes it a globally scalable program. As cities continue to be challenged by climate change with varying risk profiles, it will continue to be critical to involve local groups to develop solutions that are reflective of community needs.

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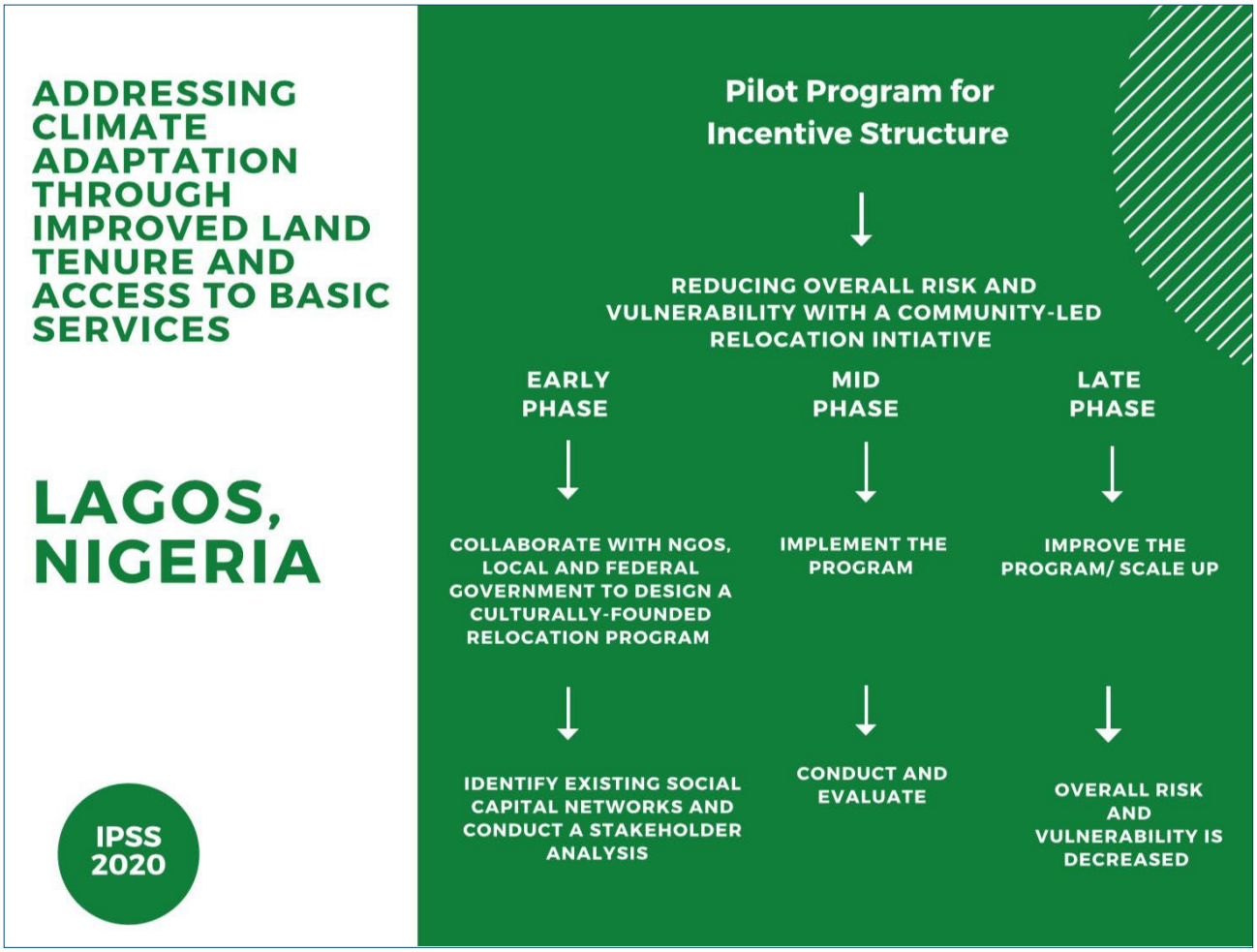
APPENDIX 1

Program Theory Of Change



APPENDIX 2

Human Cost of Forced Evictions

EVICTIONS	YEAR	NUMBER OF DISPLACED RESIDENTS
Maroko	July 1990	300000
Banana Island	January 1995	15000
Ilubirin	January 1997	15000
Badia East	October 2003	5000
Ogudu Ori-Oke	July 2008	5000
Bar Beach	August 2008	80000
Otodo Gbame	April 2017	30000
Tarkwa Bay	January 2020	4500

Source: Nigerian Slum/Informal Settlement Federation

APPENDIX 3

Case Study Of Participatory Governance In Flamingo, Cape Town

Upgradation of the Flamingo Crescent informal settlement in Cape Town, South Africa is another successful demonstration of the community-led development model. Flamingo was created in 2007 when the City of Cape Town relocated people living on streets and under bridges in Constantia, Wetton and Lansdowne to a vacant plot of municipal land in Lansdowne. By 2012, the community had grown to 405 people who resided in 104 structures. Residents shared 2 taps and 14 chemical toilets of which 7 were in working condition. All residents used contained fires in tin- drums as a source of light and heat due to the absence of electrification.

South Africa Slum Dwellers International (SDI) Alliance provided the community with social and technical support in terms of exchanges, settlement data collection (profiling and enumeration) planning, implementation and documentation and facilitated the interaction between the community and City of Cape Town. The City of Cape Town, through the Informal Settlements Management Unit, provided project management and funded the installation of basic services (water, sanitation, electricity) and road works.

After the first engagements between the community, SA SDI Alliance and City of Cape Town in 2012 and communities' exchanges to other upgraded settlements, the community began saving to make a 20% contribution to their structures. The target was achieved in 2014. The community also enumerated its settlement in 2012, using the outcome as an entry point to negotiate an improved layout with the City. In 2013, the community, with students from Cape Peninsula University of Technology SDI Alliance technical staff verified the enumeration results, surveyed the site and designed its re-blocked layout.

The project was completed in 2014. The city installed 1:1 water and sanitation points, electrified the entire settlement and paved all main access roads. The city also built a centrally located creche and multi-purpose center and a partnership with the Post Office resulted in the official naming of Flamingo's streets and the provision of recognized postal addresses.

Source: Flamingo Crescent. (2015, April 2). Retrieved from https://www.sasdialliance.org.za/projects/flamingo-crescent/

SAN JUAN, PUERTO RICO: RECOMMENDATIONS FOR A MORE CLIMATE RESILIENT FUTURE

Written by: Anna-Lisa Castle, Jessica Garcia, Katrina McLaughlin, Humna Sharif and Andrew Woods

EXECUTIVE SUMMARY

San Juan, Puerto Rico is a coastal city that has been severely impacted by natural disasters in the past five years. Resilience to climate change and related storms is a top priority in the city as it continues to rebuild and recover after Hurricanes Irma and Maria in 2017, earthquakes in early 2020, and continued sea level rise. Public and private sector actors are involved in the process of creating and executing a multitude of reconstruction project plans across Puerto Rico.

Puerto Rico has benefitted from detailed resilience planning through multi-stakeholder engagements. The following three areas of improvement could allow San Juan and the entire island to more effectively implement pending disaster recovery projects and advance long-term climate change resilience.

- **Recommendation #1 - Streamline governance structures:** improve coordination and communication amongst government actors and the public when it comes to storm-water and flood management.
- **Recommendation #2 - Build capacity and maintain institutional knowledge within Puerto Rico:** hire reconstruction consultants as permanent government agency employees, which will create new jobs within San Juan.
- **Recommendation #3 - Utilize funding and finance mechanisms that retain publicly owned assets and revenue streams:** prioritize public-private partnership models that allow the public to retain benefits from the island's resources and consider creative funding solutions, such as a climate resilience trust funded by tourism taxes.

These recommendations would increase the ability of local entities in San Juan to respond to future disasters and climate change impacts.

BACKGROUND

San Juan, Puerto Rico faces unique challenges for building resilience to climate change as a coastal city, the capital of the United States' only Commonwealth, and as the center of Puerto Rico's major metropolitan area. Puerto Rico's status as a commonwealth means that while it receives assistance from federal entities such as the Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD), it has limited political representation and its ongoing financial troubles limits the investment measures it can undertake on its own. San Juan is home to 2.6 million residents and comprises 70% of Puerto Rico's population. According to U.S. Census data, the 2019 population of San

Juan municipio[1] was 318,441, and from 2010 to 2019 the city experienced a 19.5% population loss (United States Census Bureau, 2019). Another estimate shows that Puerto Rico suffered an 8% decline in population in the immediate aftermath of Hurricanes Maria and Irma in 2017 (Hackett, 2019).

San Juan's geography creates some vulnerabilities. The island is largely tropical and coastal with San Juan positioned on the northeastern coast. As the island's major population center, much of Puerto Rico's critical infrastructure is also located in and around San Juan. This includes shipping ports, the Luis Muñoz Marín International Airport, wastewater treatment facilities, and drinking water infrastructure, some within 1 kilometer of the coast and vulnerable to sea level rise and storm surge events (Tetra Tech, 2015).

Map of Puerto Rico and the Virgin Islands (U.S. Geological Survey, 2019)

San Juan is also home to important civic infrastructure, including the University of Puerto Rico, a new convention center, and government buildings, including offices for six federal agencies. Puerto Rico's island economy is heavily reliant on imported fuels, and natural crisis driven delays or interrupted supply chains can negatively impact the economy. Additionally, most electric generating stations are located in the southern parts of the island, an area particularly susceptible to hurricanes (USGS, 2015).

Climate change will continue to impact the city through sea level rise, changing precipitation patterns, and extreme weather events including hurricanes and heat waves. Sea level rise brings a host of challenges, including increased flooding and saltwater intrusion into freshwater aquifers. Sea level is expected to rise 24-84 cm (0.8 - 2.8 ft) by 2050 relative to 2000 (Gould et al., 2018, 822). In the 2017 hurricane season, Puerto Rico was devastated by two hurricanes in two weeks, the Category 5 Hurricane Irma and the Category 4 Hurricane Maria.

1 Puerto Rico has 78 municipios, which are most analogous to mainland U.S. counties. However, these 78 municipios cover an area the size of Connecticut. Some have called for a regionalized approach to recovery efforts, which could provide greater cohesion and strengthen resiliency planning moving forward.

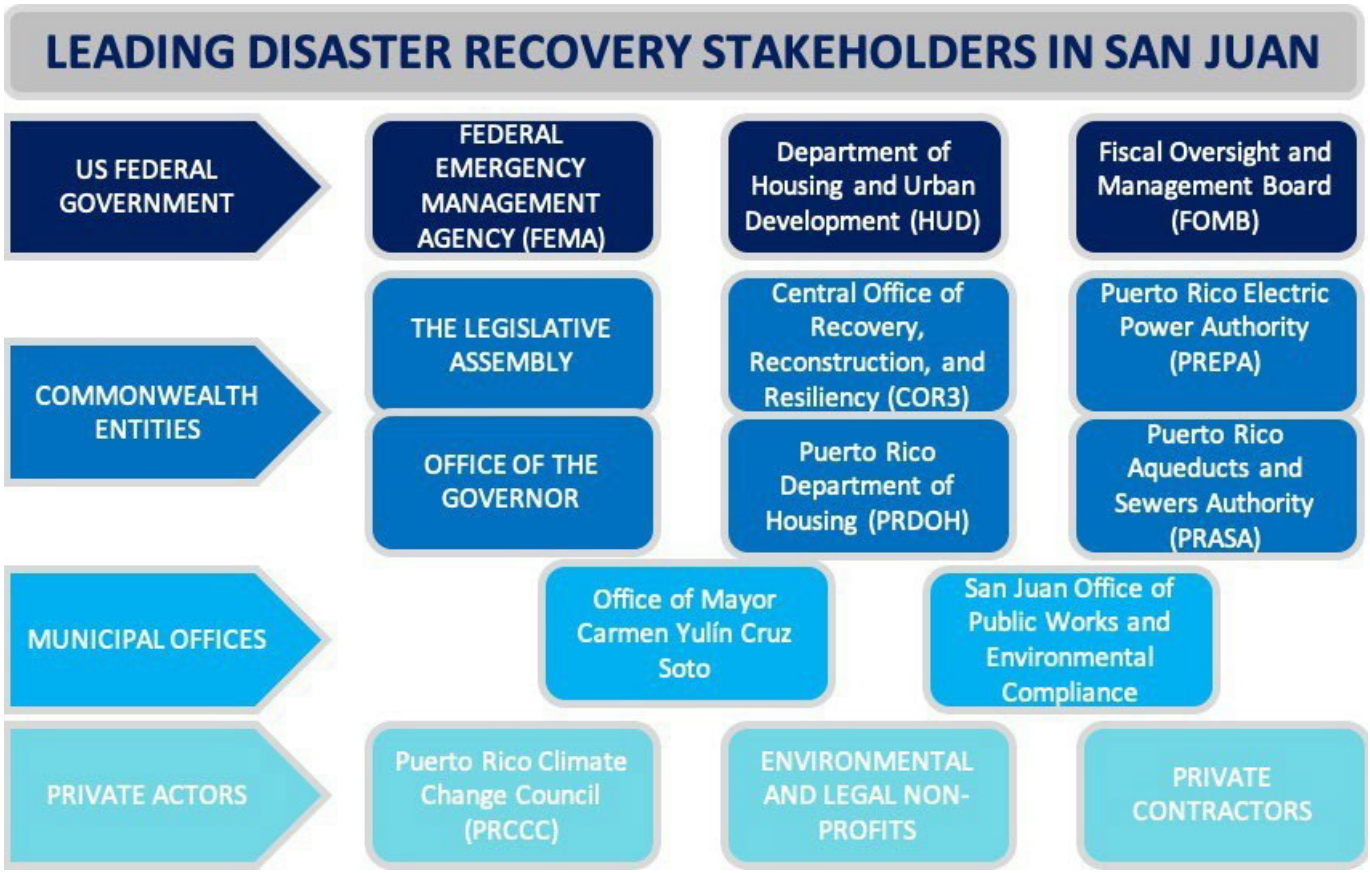
Exact estimates of economic damage and mortality events caused by the storms have been contentious and subject to debate. Conservative estimates report $90 billion in economic damages and mortality estimates range from 822 to 4,645 (Sandberg et al., 2018). While the U.S. Congress authorized more than $22 billion in recovery funds, disbursement of funds was delayed in part due to concerns by the federal government over financial management (Booker, 2020).

CURRENT STATUS OF CLIMATE CHANGE RESILIENCE IN SAN JUAN

Current climate change resilience efforts are closely linked to Hurricane Maria recovery efforts. After Hurricane Maria, the government of Puerto Rico established the Central Office of Recovery, Reconstruction, and Resiliency (COR3) (Almenas & Velazquez, 2019). COR3 is responsible for centralizing the efforts for disaster relief and management of recovery funds. Over $22 billion of federal disaster recovery funds have been obligated (i.e., pledged but not yet disbursed) to Puerto Rico (COR3, 2020). This includes over $40 million in FEMA public assistance grants and $68 million in individual assistance grants obligated to the San Juan municipality (COR3, 2020). While some of these funds are for immediate disaster recovery services (e.g. debris clean up), they may also meet climate change resiliency goals through permanent infrastructure improvements. However, the lack of public information on which specific projects have been funded limit the ability of all stakeholders to determine how disaster recovery efforts are impacting long-term climate change resiliency.

The energy sector has received the largest share of recovery funds (COR3, 2020). Hurricane Maria caused the longest blackout in U.S. history with 3.4 billion hours of electricity lost and a prolonged recovery process that left residents without essential services and power for anywhere from two weeks to ten months. As a result, significant attention has been focused on Puerto Rico's energy system in hurricane recovery planning. Ongoing efforts include the restructuring and privatization of PREPA, transitioning to meet the 100% renewable energy goal under the Puerto Rico Energy Public Policy Act signed in 2019, and building microgrid systems as a disaster resilience strategy (EIA, 2019)(DOE, 2018).

Puerto Rico's ongoing financial crisis severely limited the city's ability to make infrastructure investments prior to Hurricane Maria, and continues to complicate disaster recovery efforts. In 2016, after years of disputes between Puerto Rico and its creditors, Congress passed the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA). The Act allowed the government to restructure debts and established an appointed Fiscal Oversight and Management Board (FOMB) to provide broad supervision over funding and hurricane recovery (PROMESA, 2016). In 2017, the Puerto Rican government filed for bankruptcy under Title III of PROMESA, and FOMB has severely restricted spending and new debt which has drawn criticism over these austerity measures (Coto, 2018). In the U.S., states and municipalities use debt, such as municipal bonds, to finance about 90% of infrastructure projects (MSRB, 2019). This tool is essentially off the table for San Juan, making it more challenging and expensive to finance projects needed to rebuild and improve climate change resiliency ahead of future storms.



Private actors are also an important part of the landscape in Puerto Rico, including developers, the tourism industry, and civic organizations. The Puerto Rico Climate Change Council (PRCCC), founded in 2011, comprises members from all sectors of society including researchers, government, business, and communications experts with the shared objective of assessing damage from climate change and recommending strategies to address those impacts (PRCCC, 2017). Hurricane response efforts have brought new stakeholders, including mainland NGOs and philanthropy interests. These groups bring outside funding and capacity, but may struggle to identify the true needs of local communities and effectively coordinate efforts.

POLICY RECOMMENDATIONS

Governance, Capacity Building, & Financing for Improved Climate Change Resilience

Underlying challenges in governance, limited local capacity, and fiscal strain are exacerbating the impacts of climate change as laid out above by the National Climate Assessment and Puerto Rico Climate Change Council (PRCCC). Below are three recommendations for addressing some of these root-cause issues facing San Juan, drawing on specific examples in the fields of stormwater management, housing, and municipal finance.

Recommendation #1: Strengthen and Streamline Governance

Puerto Rico has had four governors in the last four years and political instability at the top has trickled down to the local level. According to researchers, municipal authorities insufficiently coordinated disaster preparation and infrastructure improvements with regional, Commonwealth, or U.S. federal actors. Additionally, some analyses indicate that local

authorities are not doing enough to empower local residents and experts to inform climate change preparation and adaptation (Ramsey, et al., 2019). San Juan can strengthen its approach to climate resilience efforts through the following strategies:

- **Identify lead agencies and define roles** for each level of government in addressing key climate change resilience issues and develop a unified strategy to increase efficiency.
- **Meaningfully engage residents** as both contributors and stakeholders in the development of climate change resiliency solutions.

Stormwater and flooding challenges offer a prime example. A recent article in *Environmental Science and Policy* identified problems in stormwater response coordination between the San Juan Office of Public Works and Environmental Compliance, the U.S. Army Corps of Engineers, and the Commonwealth's Department of Natural Resource (Ramsey, et al., 2019). According to Ramsey, et al. (2019), these agencies not only fail to coordinate effectively, but they continue to: 1) underutilize available data, produced by entities such as the PRCCC, for flood scenario development, 2) underfund flood planning projects, and 3) do not do enough to prevent building in flood prone zones. This has led existing stormwater infrastructure to fail and reduce San Juan's ability to implement long-term risk reduction measures. As recently as last year, when local flooding was reported, no agency claimed responsibility for the clean-up and infrastructure repairs (Arsuaga, 2020). One solution is to identify and entrust a single agency or coalition focused on stormwater and flood management, of which currently there is not one (Ramsey, et al., 2019).

In addition to reorganization of internal governmental structures, San Juan should also look to further engage its citizens in the management of flooding and stormwater. One example is to empower the general public to report problems to authorities before they become serious. The benefit is residents have first-person knowledge about the location and magnitude of flooding events around their neighborhoods and can act on that information before authorities (Ramsey, et al., 2019). This could be as basic as having a mobile phone application for residents to report flooding in their neighborhoods.[2] Yet researchers who have suggested this say such proposals have been dismissed by authorities who exhibit a persistent view of local residents as "passive consumers or recipients of information instead of active agents or producers of knowledge" (Ramsey, et al., 2019, p. 2; Coles & Quintero-Angel, 2017). In not taking public input and reporting seriously, authorities are limiting the data upon which they could improve systems for monitoring, documenting, and interpreting flooding data in San Juan (Ramsey, et al., 2019).

In summary, to improve stormwater management the San Juan Office of Public Workers and Environmental Compliance and the Commonwealth's Department of Natural Resources need to work together to enact measures to increase efficiency, effectiveness, and coordination with each other, residents, and other key stakeholders. This coordination and engagement can be a valuable part of San Juan's climate change resiliency strategy while offering an opportunity to educate residents and institutions on its impacts.

Recommendation #2: Build Workforce Capacity and Retain Institutional Knowledge

As San Juan and Puerto Rico as a whole grapple with recovery efforts and resiliency planning, the agencies leading this work are managing administrative and operational burdens associated with accessing federal funding and organizing, tracking and coordinating efforts. This can give way to misalignment, inefficiency and missed opportunities. A key observation of civic leaders in San Juan has been the prevalence of appointed positions and the use of private consultants by government agencies rather than hiring local career personnel (Blázquez, 2020). This practice exposes climate change resiliency work to an additional layer of risk, with greater potential for turnover of

2 Beyond this particular example, increasing the resilience of telecommunications infrastructure is critical. Communications infrastructure was unavailable in the immediate aftermath of Hurricane Maria, impacting emergency response measures.

project-critical staff with the political cycle or due to contractual limitations and other factors. San Juan officials should consider the following actions and approaches:

- **Prioritize local workforce development and hire career professionals,** which would help sustain institutional knowledge, create consistency in policies and procedures being implemented within government agencies, and offer long-term economic benefits locally
- **Institute merit-based hiring systems and reduce the number of appointed positions** to increase efficiency and continuity of climate resilience efforts
- **Engage residents and document local knowledge** to improve understanding of local conditions affecting recovery and resiliency planning and strengthen the qualitative and quantitative data that informs decision-making
- **Work with FOMB and stakeholder agencies** to identify best practices and develop actionable strategies to achieve workforce development and agency capacity goals

There are several benefits of investing in local leadership and creating recovery and resiliency related jobs within San Juan, including a reduced reliance on federal agency capacity and outside consulting firms in the long-term. Locally-hired professionals are also more likely to be invested in the long-term welfare of the city. More career positions and instituting a merit- based hiring system would also help address San Juan's current unemployment status which stands at 7.5% as of December 2019 (U.S Bureau of Labor Statistics 2020). Additionally, centering decision-making and planning at the local level may reduce inefficiencies associated with the current dominance of bureaucratic federal agencies, such as FEMA, and private U.S.- based consultants in the recovery effort. For example, after the 2017 hurricane season, COR3 hired several mainland U.S. consulting firms to aid with the process of disaster relief management (Almenas & Velazquez, 2019). Among these firms, Deloitte alone has signed 10 separate contracts with COR3 worth more than $70 million to develop hurricane recovery plans (Almenas & Velazquez, 2019). As Deloitte advises COR3, San Juan should work to ensure that the strategies that emerge from these contracts are vetted for local relevance, institutionalized where applicable, and used to strengthen local capacity for response, recovery, and resilience planning and implementation over the short-, mid-, and long-term.

Lack of institutional coordination is also apparent in the housing recovery efforts being undertaken. With the oversight of FEMA, HUD provides housing relief funds in the form of Community Development Block Grant-Disaster Recovery (CDBG-DR) funds (HUD Exchange, 2020). The Puerto Rico Department of Housing (PRDOH) and COR3 were designated as the primary agencies responsible for administering CDBG-DR funds (COR 3, 2020). Concerns over the local government's capacity to handle disaster relief has led to HUD imposing strict requirements over the $8.3 billion of allocated CDBG-DR funds, which the Commonwealth has largely been unable to access (Garofalo, 2020). Despite having multiple federal and local agencies assigned to the task, there is a lack of information on housing characteristics and tenure. Following Hurricane Maria, over 60% of FEMA Individual Assistance grants were rejected because homeowners did not have FEMA-required land titles, or because applications were submitted with unnotarized signatures (Viglucci, 2018). The island has a longstanding tradition of passing property from generation to generation without formal titles, and many new structures have been built on land holdings without permits and official records. Even when FEMA changed application requirements, this information was not published widely due to limited capacity of local administrative agencies.

According to civic leaders, to date, a comprehensive database of formal and informal housing areas does not exist, and agencies do not have a clear understanding of community needs (ReImagina Puerto Rico, 2019). Not only does this knowledge gap create challenges in accessing and distributing CDBG-DR funds, it also hinders the ability of decision-makers to center climate resilience and public health by, for example, curbing the practice of building in flood zones.

Many of these systemic inefficiencies can be addressed by building local institutional capacity, and redirecting funds towards creating permanent government positions within the Commonwealth. Retention of local knowledge and hiring career personnel will create a more resilient city while also strengthening the local economy.

Recommendation #3: Develop Sustainable Funding and Financing Strategies

Puerto Rico is an island with high vulnerability to extreme weather, long standing political instability, and virtually no ability to take on new debt as it attempts to recover from both bankruptcy and destruction from natural disasters. Frustration has mounted around the municipal and the Commonwealth governments' inability to access federal funding. For example, of the more than $20 billion allocated through the CDBG-DR, only about $1.5 billion have been released thus far. According to the Government Accountability Office, the island has spent less than 1% of funds obligated for permanent work by FEMA (GAO, 2020). At the same time, San Juan and Puerto Rico have virtually no ability to independently finance projects by taking out new debt. Additionally, much of the existing reserves are earmarked for debt payments, which are still being hashed out by FOMB and the federal government as the island's debt is being restructured.

Mayor Cruz Soto and other city leaders should work strategically with Commonwealth authorities, federal agencies, philanthropic foundations, community organizations, and business leaders to take the following steps:

- **Develop a unified strategic plan to build and demonstrate strong management capacity needed to secure federal funding** already obligated for Puerto Rican agencies (many of which are headquartered in San Juan), municipal governments, and businesses.
- **Create a broad development strategy to secure and manage both public and private grants,** including investments like those made by Ford Foundation, Open Society Foundation and Rockefeller Foundation (Ford Foundation, 2017).
- **Prioritize public-private partnership (P3) arrangements that allow the city to retain long-term control and ownership of its assets.** "Public-private partnership" broadly refers to an arrangement in which a government enlists a private partner to invest in the development and/or maintenance of a capital project in exchange for a portion of revenues generated by the asset (Marlowe, 2015). As an alternative to debt financing to support resilience efforts, San Juan should strategically utilize P3s and, with federal funds in hand, pay-as-you-go strategies.
- **Identify opportunities to generate dedicated revenue streams** to fund resiliency efforts by capitalizing on existing local assets and investments, including the growing tourist economy

San Juan has recently taken steps to bolster its tourism economy, including the development of a new entertainment district, El Distrito, a new convention center, and adjacent hotels (El Distrito, n.d.). These efforts may be paying off, with the official tourism organization, Discover Puerto Rico, reporting record revenues of $445 million by June of 2019 (PR Newswire, 2019). As the tourism industry continues to grow, San Juan could consider reevaluating room occupancy taxes, currently 7-11% depending on accommodation type, paired with the establishment of a trust to fund climate change resilience projects (Best Hotels, n.d.).

For example, one model to consider is the "Coastal Zone Management Trust" in Mexico. This trust was collaboratively developed by The Nature Conservancy (2019), the state government for Quintana Roo, the National Parks Commission, and hotel owners. The distribution of these funds is managed by a small coalition of public and private entities including government agency officials, hotel owners, and resiliency experts. The City of San Juan could work with the Commonwealth to create a climate resiliency trust fund, similar to the Quintana Roo model. The Commonwealth, which imposes the occupancy tax, could either institute a small increase for the city or re-direct

existing funds, which have so far gone towards paying off projects such as the construction of the new convention center (Guadalupe-Fajardo, 2001). City officials could then work with public agencies and non-governmental organizations to ensure that the generated funds are strategically invested in projects that will deliver resilient outcomes for its communities.

CONCLUSION

The recommendations listed in this brief advocate the need for climate change resilience in San Juan and across Puerto Rico especially as it rebuilds to withstand future storms. San Juan would benefit from providing a competitive workforce and local economy for its citizens alongside its increasing tourism. This, and general climate change resilience could be more efficiently accomplished by streamlining governance, building and maintaining institutional knowledge on the island, and improving municipal access to existing federal funds while also creating new revenue streams for San Juan.

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SANTIAGO DE CHILE'S WATER CRISIS: RECOMMENDATIONS FOR CLIMATE CHANGE ADAPTATION

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EXECUTIVE SUMMARY

Santiago de Chile is already facing climate change impacts, including less overall rainfall, less snow accumulation due to higher temperatures, and longer and more frequent droughts. Meanwhile, demand for water is steadily increasing. Unless something is radically changed, Santiago's water source, the Maipo River Basin, and everything it supports will rapidly diminish in the face of climate change and increased demand from population and economic growth.

While we may be unable to stave off the worst impacts of climate change, we can create socioeconomic systems that are more resilient to future change. Currently, Chile is the only country in the world that has a privatized water system, with severe consequences for affordability, governance, and effectiveness. Considering these challenges, the City of Santiago and the Chilean government should implement the following recommendations:

- Adopt an Increasing Block Tariff pricing structure to incentivize reduced water consumption, increase the revenue of Chile's water management authority, the Dirección General de Aguas (DGA), and lower the financial burden on low income households.
- Establish a Voluntary Basin Management Accord for the Maipo River Basin and support the creation of more structured water users associations to manage water resources and resolve conflict across the entire basin.
- Expand the DGA's authority and establish it as a central coordinating entity that can support integrated water resources management practices and ensure equitable allocation of water.
- Increase funding for the DGA to improve monitoring, reduce information gaps, and improve surface water and groundwater resource management.

Resilience is the power to not only bounce back to a highly inequitable status quo, but to continually build toward an equitable future despite stresses and shocks to the city. In Santiago, this may only be achieved through structural change. This brief offers such a path forward.

BACKGROUND

Santiago de Chile faces a water crisis. Agriculture, industry, and a growing population of over six million people in the metropolitan area rely upon the Maipo River Basin for their water needs (Elugueta et al., 2017; OECD, 2017). To make matters worse, the growing demand for water is met by a shrinking supply due to climate change (Becerra et al., 2019).

The Maipo Basin is located to the east of Santiago in the semi-arid region of Central Chile and supplies 90 percent of the region's water for irrigation for agriculture, 80 percent of the Santiago Metropolitan Region's (MR) potable water, and water for economic activities (Becerra et al., 2019). The basin is replenished by rain in winter and snowmelt from the Andes in summer (Gerardo et al., 2013). However, in recent decades, the Maipo's major inputs have been declining (Figure 1). Climate change is already reducing rainfall, increasing temperatures that reduce snow accumulation, and leading to longer and more frequent droughts in Santiago de Chile. Altogether, models predict a 40 percent decrease in the water flow to the Maipo Basin over the next half century (Becerra et al., 2019).

Meanwhile, demand for water is increasing. The MR accounts for approximately 40 percent of Chile's population and generates about 45 percent of its GDP (Becerra et al., 2019). Population and economic growth have meant increased water demand, especially among water-intensive industries including mining, fish farming, agriculture, and forestry (OECD, 2017).

A critical resource for life and an economic powerhouse for the region, the Maipo Basin faces an all but certain future. Unless something is radically changed, the Maipo Basin and everything it supports could rapidly diminish in the face of climate change and population and economic growth. If the Maipo Basin is to be recovered, we must consider two major challenges facing not just Santiago, but the country as a whole: inequality and fragmented governance.

Chile has Awoken: Inequality and the Call for Change

Since the return of its democracy in 1990, many have considered Chile a glowing success. The country has the highest GDP per capita in the region and is ranked as the most economically competitive country in Latin America. In October 2019, President Sebastian Piñera called Chile an "oasis" amidst regional social unrest (Langman, 2019). Yet, just days later, a marginal increase in metro fares sparked massive civil unrest in the capital city of Santiago. Despite continued economic growth, Chile had become the 15th most unequal country in the world, where the wealthiest 1 percent held 33 percent of the wealth (Garreton, 2017; Langman, 2019).

Containing both the six best and the six worst municipalities to live in the country, the MR is at the forefront of Chile's extreme inequality. As Fernandez et al. (2016) suggest, Santiago may indeed be trapped in a cycle of "bad resilience," wherein feedback loops lock the city in entrenched inequality following the decades-long institutionalization of neoliberalism that deprives the poor of quality assets essential to human development.

Chile is the only country in the world with privatized water (Carey-Webb, 2019). Users are subject to some of the highest water tariffs in Latin America and many, as a result, are highly indebted to their water utilities (Bouyé, 2019; Pflieger & Matthieussent, 2008). Due to poor infrastructure and relative distance from the Maipo Basin, the MR's poor pay more than the rich per unit of water (Duran, 2015). In addition, they are also more likely to suffer water shutoffs in the face of indebtedness (Pflieger & Matthieussent, 2008). Despite the high costs, 35 percent of drinking water is lost due to leaky pipes and poor infrastructure (Bouyé, 2019).

After protests broke out in October 2019, Chileans have advocated for targeted social and economic reforms, including an overhaul of the water system. In total, 74 percent of Chileans are in support of public ownership of water (Bouyé, 2019). Chile has already seen internal climate migration due to a decade-long drought (Rojas, 2019). Unless the underlying causes of inequity are addressed, climate change – which is predicted to cost Chile 1 percent of its GDP annually over the next 80 years – could work to destabilize the country and exacerbate social inequalities (Becerra et al., 2019).

Fragmented Governance

The fragmented nature of Santiago's water ownership presents a unique challenge for governance and stems from the neoliberal policies institutionalized under the military dictatorship of Augusto Pinochet. Enacted under Pinochet, the nation's constitution is extremely rigid and has all but ensured the continued privatization of essential services including health care, education, energy, and water (Troncoso & Becerril, 2019). The privatization of the water supply specifically was born from the establishment of the Chilean Water Code in 1981, a Pinochet-era policy granting water rights to private users (Becerra, 2019) Today, Santiago's water supply is managed by a conglomeration of private foreign companies, which are primarily headquartered in Spain (Lobina & Hall, 2007). Exacerbating both the inequality and fragmentation resulting from private ownership, the Maipo River Basin is governed in three separate sections. Furthermore, the authority to make meaningful changes to the water system that could address water scarcity lies with the Chilean government — not the City of Santiago.

PROPOSED POLICY SOLUTIONS

Members of Congress and presidential administrations have proposed a variety of modest reforms to the Water Code since its passage in 1981. Meanwhile, NGOs and activists seek structural change beginning with the rewriting of the national constitution and eventual nationalization of the water system. Due to the success of recent protests and advocacy efforts, Chilean citizens will vote on a referendum on whether to host a constitutional convention in October 2020, and water would likely be a crucial part of the constitutional framework reform if the referendum passes (Cuffe, 2019). While true resiliency — the capacity to to not only bounce back to a highly inequitable status quo, but to continually build toward an equitable future despite stresses and shocks — can only result from deep structural change, there are several policy solutions that can build long-term resilience regardless of the outcome of the constitutional referendum. Within the MR, technological and infrastructural solutions can be implemented, including improved water distribution systems and green stormwater infrastructure that can mitigate flooding and recharge aquifers. In this brief, however, we focus instead on addressing systemic issues through two key policy areas: pricing system reform to ensure equitable distribution and use of water and the adoption of sustainable management practices. In doing so, we hope to provide a blueprint for water governance in the case of constitutional reform or, in its absence, a platform on which the City of Santiago and water justice advocates may continue the fight.

Equitable Pricing and Water Usage

The MR is facing two key problems with regards to water availability and equity: 1) household water usage is increasing despite a shrinking supply from the Maipo Basin; and 2) the current water pricing structure imposes proportionally higher financial costs on low income households.

In the absence of austere water usage behavior in Santiago, with parts of the city consuming over 600 daily liters per capita, the Maipo is expected to be depleted by 40 percent by the year 2070 (Nature Conservancy, 2019). As the water supply decreases, the people of Santiago continue to use an excessive amount of water for swimming pool maintenance, sidewalk dampening and long showers, with no incentives to decrease consumption levels. Moreover, despite the proportionally higher utility rates for lower income populations, water consumption is higher among the upper to middle class groups of Santiago (Durán, 2015). The often regressive relationship between water usage and the amount charged to households throughout the city creates disparity in water affordability among Santiago residents to the extent that the poor are defaulting on utility payments for water while wealthier residents enjoy proportionally cheaper water for luxury uses. Without appropriate state regulations, this disparity has widened over the years; Although lower income communities have access to potable water, the consumption gap between rich and poor has widened significantly in recent years.To alleviate unequal cost and consumption patterns, the City of Santiago should work with the Chilean government to:

- **Adopt an Increasing Block Tariffs ("IBT") pricing structure to incentivize reduced water consumption, increase the revenue of the DGA and lower the financial burden on low income households.**

Successfully implemented in countries such as South Africa and Brazil, IBT pricing increases the per unit rate of water with higher consumption levels per household, thus accurately reflecting the spending patterns per socioeconomic level (Oliver, 2006). The increased rate paid by wealthier communities with higher usage would serve to subsidize the cost of water for lower income residents, consequently democratizing the pricing allocation and leveling the spending across the board. The higher rate may concurrently incentivize users to reduce their water usage, especially if paired with an educational campaign focused on responsible water consumption.

To prevent measuring errors that overcharge families, the DGA must maintain effective oversight of consumption by monitoring water meters installed in households and identifying and replacing shared watershed sources commonly found in low income communities, which make it difficult to differentiate the usage per household (Durán, 2015). By doing so, spending levels could be appropriately tracked and allocated to each household without overcharging families due to measuring errors. Therefore, since the upper-middle class citizens of Santiago have higher per capita consumption, the implementation of the IBT will potentially increase overall utility revenues from water usage to fund the oversight and water distribution throughout the city.

Sustainable Management

As rainfall becomes more variable and glaciers recede, local and national government agencies must implement sustainable management strategies to maximize the use of limited water resources. For the City of Santiago, this means establishing a Voluntary Basin Management Accord; and for the Chilean government, increasing the authority and funding of the DGA.

Establish a Voluntary Basin Management Accord

As mentioned previously, the basin is divided into three sections for administrative purposes, despite the hydrologic connectivity of the sections (Figure 2). Water users in the first section are under no obligation to coordinate with users in the second and third sections, which has led to diminished water supplies for downstream users (Borgias and Bauer, 2018). Furthermore, the Water Code separates groundwater and surface water rights despite their hydrological connection. An estimated 20 aquifers in Santiago are over-allocated, meaning that the rights to pump groundwater exceed the available water supply (Ministerio del Interior y Seguridad Pública, 2015). Integrated water resources management (IWRM), defined by the Global Water Partnership (2011) as "a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment", has proven successful in other large river systems (e.g. the Rhine River basin) In other Chilean regions, IWRM has been pursued through Voluntary Basin Management Accords (Acuerdo Voluntario para la Gestión de Cuencas, AVGC) (Becerra et al., 2019). In order to pursue integrated river basin-wide management, the City of Santiago should:

- **Establish a Voluntary Basin Management Accord (AVGC) for the Maipo River Basin and support the creation of more structured water users associations to manage water resources and handle conflict across the entire basin.**

Water users associations (WUAs) are crucial to any basin-wide management planning effort. WUAs have existed in Chile since the early 1800s but are not currently fulfilling their intended

purpose in the Maipo River Basin. The Water Code outlines three specific types of WUA: water communities (comunidades de agua), canal associations, and vigilance committees (juntas de vigilancia). The vigilance committees consist of "users that in any way utilize waters from the same watershed or hydrographic basin" (Borgias and Bauer, 2018) and they are supposed to manage water distribution, conflict resolution, and construction and maintenance of water infrastructure in their region (Becerra et al., 2019). In practice, only the first section of the Maipo River has a fully functioning vigilance committee, while the second does not have a committee at all and the third is loosely organized. The second and third sections thus have the most conflicts over water rights. Located the furthest from the Maipo Basin, these sections are home to more low- income households, charge higher fees for water to accommodate added infrastructure costs, and are the most vulnerable to drought. Additionally, groundwater users, such as farmers and larger agricultural corporations, are not integrated into any formal management of the basin, which makes it challenging for users to effectively navigate conflicts, especially in times of drought (Becerra et al., 2019). With support from the City of Santiago, a stronger system of WUAs under the AVGC would enhance integrated river basin management.

Increase DGA authority and resources

While the City of Santiago can pursue an AVGC in conjunction with other municipalities and water users, the impact on water resources will be limited unless the Chilean government takes further action. In theory, the DGA is responsible for water resources planning, regulating water rights, monitoring water in natural channels, and supervising WUAs throughout the country (OECD, 2017). However, the DGA is currently prohibited from intervening in the water market except in periods of extreme drought or other rare circumstances (Morán, 2014). Additionally, in practice, they do not have the resources to effectively oversee and monitor groundwater rights and uses (The World Bank, 2015). In the Santiago Metropolitan Region, the DGA could serve as a convenor for the more than 40 water-related institutions in Chile (OECD, 2017) and a supporter of WUAs. To address these issues, the City of Santiago should encourage the Chilean government to:

- **Expand the DGA's authority and establish it as a central coordinating entity that can support integrated water resources management practices and ensure equitable allocation of water**
- **Increase funding for the DGA to improve monitoring, reduce information gaps, and improve surface water and groundwater resource managem**ent

Strengthening DGA's authority and resources would improve their ability to support basin-wide management and implement programs such as the aforementioned IBT pricing structure. The resiliency of Santiago's water supply depends on a coordinated response from both local and national actors.

CONCLUSION

Santiago de Chile's water crisis is emblematic of the constitutional crisis at hand. The privatization of the water system, fragmented water governance and management, and inequitable pricing and consumption can be traced to Pinochet-era reforms. Together, these challenges work to undermine resiliency efforts as Santiago attempts to adapt to a changing climate and address longstanding citizen concerns. For these reasons, we join Chilean organizations and activists in their call for nationwide reform including an overhaul of the water system. By adopting a new water pricing structure, pursuing integrated basin-wide management, and strengthening the DGA, Santiago will gain more control over its water system and become a more resilient and equitable city.

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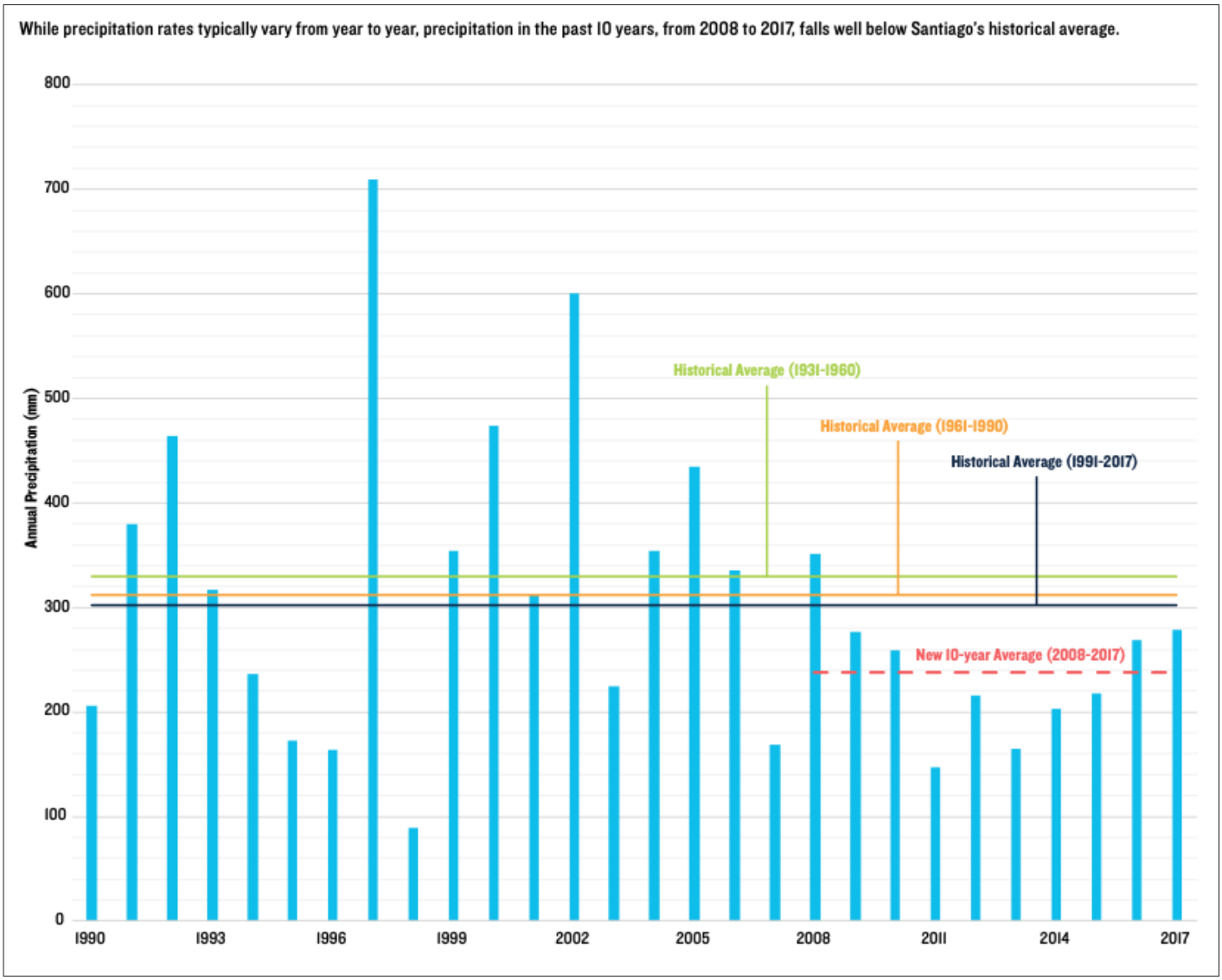
APPENDIX

FIGURE 1

Annual precipitation in Santiago (mm)

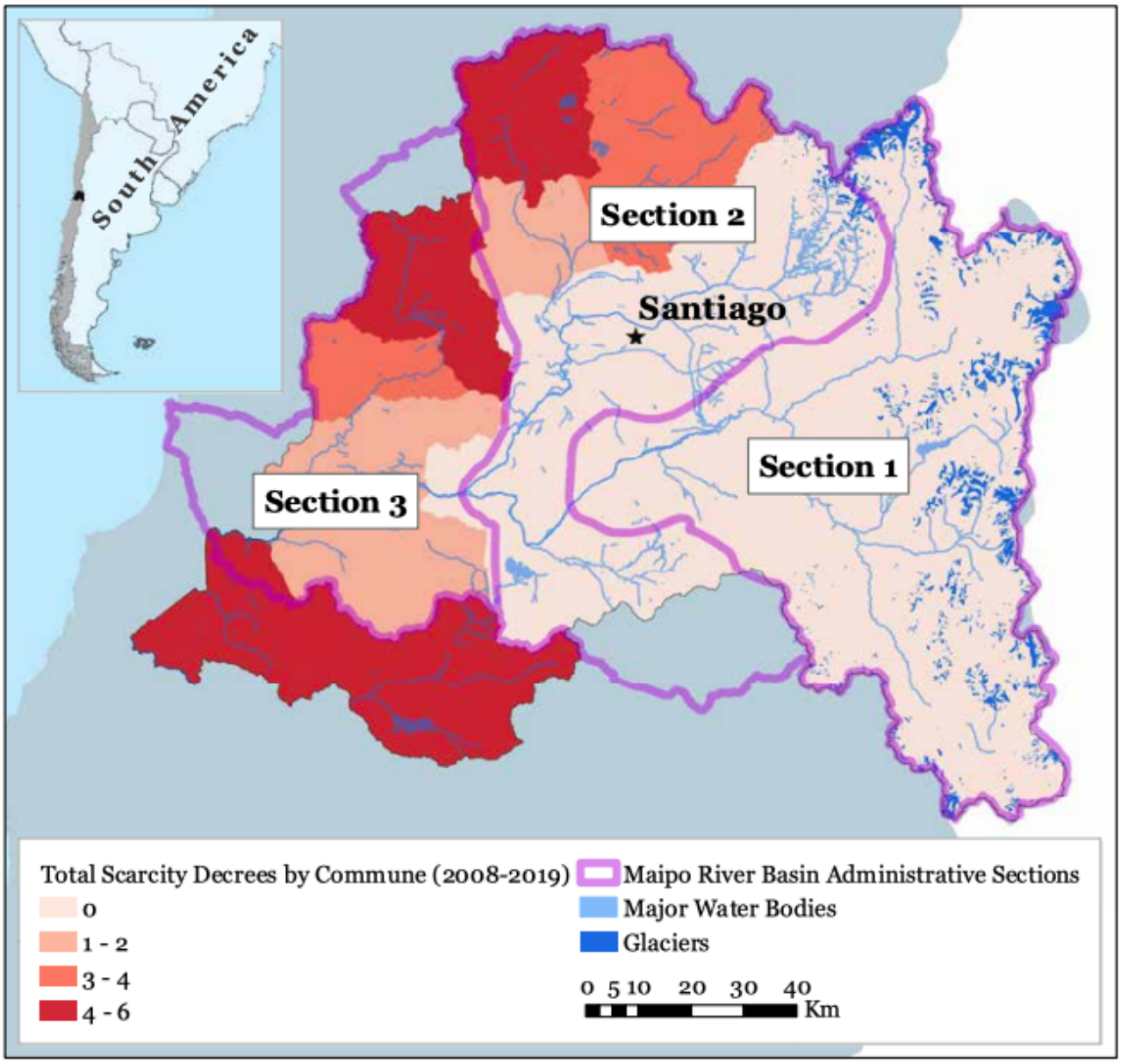


Source: Becerra, Andrea E. "A New Course: Managing Drought And Downpours In The Santiago Metropolitan Region." Adapt Chile. *Natural Resources Defense Council. Figure developed by the authors using data from the Annual Climatology Report by the Meteorological Directorate of Chile (DGAC) for the years 1990-2017.*

FIGURE 2

Water scarcity by commune in Chile's Metropolitan Region

Scarcity decrees issued by the government between 2008-2019 serve as a proxy measure for vulnerability to drought by commune. The purple outline represents the Maipo Basin's three administrative sections. The basin encompasses most of the MR, demonstrating why water management at this regional level requires an in-depth understanding of the Maipo Basin. The first section begins at the headwaters in the Andes, followed by downstream sections two and three where the most vulnerable communes can be found (Til Til, Colina, Curacavi, and part of San Pedro, shaded in the darkest red). Alhue, outside the Maipo Basin but within the MR, also received the most scarcity decrees.[40]



DATUM WGS 1984, Projection UTM, Zone 19S
Data Source: Consbio (2011), General Water Directorate (DGA) (2008-2019),
National Congress Library of Chile (2008-2011), National Statistics Institute of Chile (2017)

Source: Becerra, Andrea E. "A New Course: Managing Drought And Downpours In The Santiago Metropolitan Region." Adapt Chile. Natural Resources Defense Council. *Map created by the authors with ArcGIS.*

ADDRESSING CLIMATE-DRIVEN FLOOD IMPACTS IN VENICE, ITALY THROUGH SUSTAINABLE TOURISM

Written by: Josh Clement, Felicia Crivello, Matt Kowalsky, Patrick Ronk

EXECUTIVE SUMMARY

This memo addresses sea level rise and flooding with concurrent subsidence in Venice, Italy. An under-construction sea wall known as MOSE (an Italian acronym that translates to Experimental Electromechanical Module) should protect Venice from substantial flooding for the next 30 to 50 years by managing sea-level rise. MOSE provides a few decades of "breathing room" for Venice to pursue localized adaptive solutions in response to climate-driven flooding impacts. Exacerbating the flooding issues, overtourism is accelerating historical infrastructure degradation, negatively impacting the health of residents and contributing to resident migration. This memo proposes leveraging Venice's booming tourism industry to provide increased funding for climate adaptation measures to work in conjunction with the MOSE seawall.

INTRODUCTION

Venice is located in Italy, along the northern coast of the Adriatic Sea. It's city center is located on a series of islands such as those of Murano and Burano within the Venetian lagoon. The water level within the lagoon is shallow and fluctuates due to ocean tides and wind. Salt marshes and wetlands ring the coasts of the lagoon. Most of Venice's structures sit upon wooden pilings that were driven into the marshy ground. A base of stone, generally limestone, sits upon the pilings, completing the foundations. The majority of the visible portions of Venice's buildings, facades, walls and roofs are constructed of brick and terracotta tiles (Cooper, 2019). Frequent saltwater flooding leaves salt deposits on the surface and within the pores of the brick and terracotta leading to degradation and destruction.

The cities' residents have become accustomed to flooding and have already begun to adapt in their own ways. Many residents place barriers outside ground-level building entrances to limit water intrusion and pump out any water that seeps in. Raised walk-ways have been constructed throughout the city center to help tourists and locals navigate without sloshing through deep puddles. While these measures alleviate some of the burden, climate change is increasing the frequency and intensity of flooding. Venice currently faces about twenty substantial flood events each year, with each causing between $10 to $30 million in damages (Vergano and Nunes, 2007).

CURRENT STATUS OF CLIMATE RESILIENCE IN VENICE

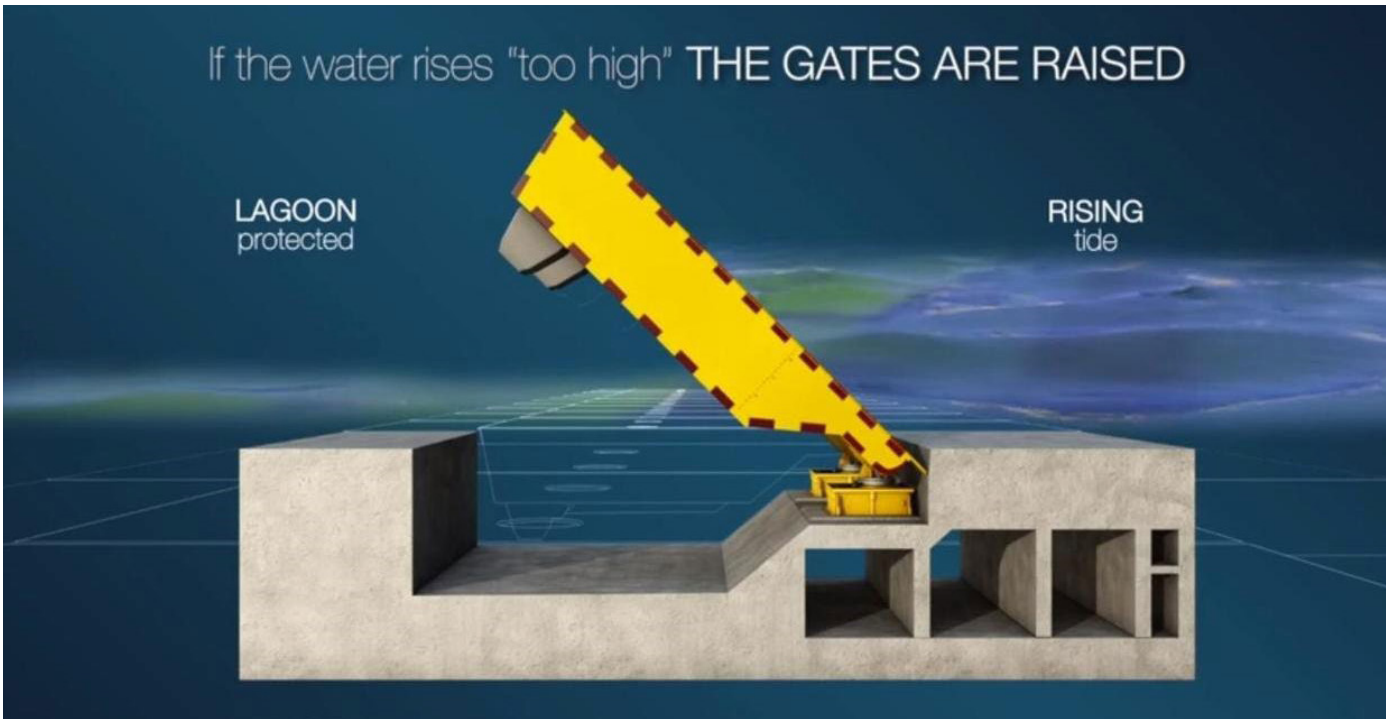
Venice is a participating city in the C40 Cities, a network of the worlds' megacities that are working towards adapting to climate change (C40, 2019). Within the last 50 years, Venice has been working to keep the city afloat. The city's main large-scale adaptation measure to manage rising sea levels

and protect the city from increased climate-driven flooding is the seawall system MOSE (an Italian acronym that translates to Experimental Electromechanical Module). When water levels reach a certain height threshold, the seawall will raise, as demonstrated in Figure 1. MOSE will seal off the three inlets to Venice's lagoon during potential high flood-risk weather events (Masters, 2019). MOSE is predicted to protect the city from rising sea levels for the next 20-50 years, its completion set for 2022.

MOSE can raise and lower, allowing Venice's busy tourist and industrial ports to function without disruption during stable weather conditions. MOSE was designed to protect Venice from sea level rise up to 60 cm (Harlan and Pitrelli, 2019). However, the International Panel on Climate Change estimates that by 2100 Venice will face sea level rise of 30 to 100 cm (Molinaroli, Guerzoni, and Suman, 2019). The estimates show sea level rise could surpass the 60 cm level within the next 30 to 50 years. MOSE will ultimately provide Venice with a few decades of "breathing room" to pursue localized adaptive solutions.

FIGURE 1.

A cross-section of MOSE. The illustration shows MOSE being raised to protect Venice from flooding.



Compounding the flooding issues, overtourism is contributing to resident migration, accelerating historical infrastructure degradation, and negatively impacting the health of residents. At least 25 million tourists visit the city each year, approximately 70,000 per day (Hardy, 2019). The floods and crowds of tourists have made living in Venice less desirable to residents. The population of the city center was approximately 170,000 in the 1950s and has reduced to approximately 50,000 to date (Albanese, Salzano, and Vespignani, 2019). On any given day, tourists are likely to outnumber locals. Many tourists arrive via large cruise ships that create wakes and raise water levels within the lagoon and its canals which accelerates infrastructure damage. The cruise ships also pollute Venice's air, causing increased particulate levels which are linked to health problems such as cardiovascular and respiratory diseases (BBC, 2017). At this time, the Venitian government has passed legislation banning large cruise ships from docking in the city center's lagoon as a way to reduce some of these negative externalities. Other efforts surrounding eco-tourism include banning new pop-up souvenir shops that sell plastic items that end up polluting the city and fining tourists upwards of 500 euros for "misbehaving" (e.g., sitting on steps of churches with food (Vogt, 2019).)

PROPOSED POLICY SOLUTIONS

In the short-term, Venice should take advantage of the "breathing room" MOSE will provide and focus on encouraging localized climate change resilience and supporting economic growth centered on the long-term residents of Venice. Community engagement should be prioritized throughout the decision-making process, which may include hosting public forums, town halls and opening an online space to encourage direct feedback from Venice's residents and business owners. The city should also launch education outreach programs and embark in civic/stakeholder engagement efforts. This community participation component should not be overlooked, as doing so will encourage the creation of networks amongst residents and business owners and enhance knowledge surrounding climate-driven impacts on the city.

SUSTAINABLE TOURISM

Over-tourism in Venice is a significant negative externality for the people of Venice. While the overwhelming number of visitors contribute heavily to the cities' economy (Statista Research Department, 2020), providing over €2 billion in annual revenue (Hardy, 2019), they have made the most historic parts of Venice effectively unlivable for long-term residents. The "breathing room" period offers the city the opportunity to reach a lower, more sustainable level of tourism, where Venice's economy does not suffer too drastically and the city's permanent residents are able to build a more comfortable and improved quality of life. Research suggests that a more sustainable carrying capacity of tourism for Venice is about 20 million visitors per year, down from current levels of about 25 million tourists annually (Bertocchi et al., 2020). Reaching this optimal level will reduce not just foot traffic and environmental wear and tear in the city, but will also decrease some of the heavy pollution brought by large cruise ships into the lagoon.

Venice can achieve this desired level of tourism by internalizing the cost of overtourism on visitors to the city via two forms of Pigouvian taxes on tourism: a Hotel Tax and a Day Trip Tax. Since 2015, Venice has charged visitors who stay overnight in the city's hotels a small Hotel Tax. The charge varies depending on the quality of the hotel, with tourists paying more depending on how many stars their hotel has (Calder, 2018). As currently applied, the Hotel Tax does not apply to the Airbnbs proliferating around the city's historic center. This should be amended and the charge should be applied to all Airbnb rentals the same as it is to current hotel stays.

Millions of Venice's annual visitors come to the city for day trips. Whether by cruise boat or train, many visitors come to the city for less than a twenty-four period, meandering throughout the city and visiting its famous sites and then departing without staying in a hotel or Airbnb overnight. Starting July 1, 2020, Venice is enacting a Day Trip Tax on tourists, built into the ticket price of their mode of transportation into the city. The size of the tax changes based on the date of visit, with visitors being charged more during the busy season and less during quieter months (Turner, 2019).

Leveraging these two taxes and ensuring that the Hotel Tax is applied to Airbnb rentals will gradually drive down tourism through increased visitation prices. Estimating the ideal rate of taxation to reach 20 million visitors per year will take time and rest on economic research into finding the elasticity of travel into Venice. After a few years and multiple tax adjustments, however, the Venetian municipal government should be able to adjust their annual visitors to a sustainable level and generate significant new tax revenue in the process. Other cities, such as Amsterdam, have sought similar taxes on Airbnbs in order to reduce tourism levels past what they believe are acceptable for their cities (Rodriguez, 2018).

While there is uncertainty on the capture rate of Venice's tourist taxes, an average tax rate of 4 euros per day tourist and 6 euros per overnight tourist is in line with the average taxes from other Italian cities such as Rome, Milan, and Florence (Italian City Taxes, 2019). Venice currently plans to charge day trippers €3 during the low season, €8 ($8.78) during high season and €10 during "critical" periods, such as summer weekends (Turner, 2019).

Cities across the world are seeking similar solutions to manage overtourism, including Rome, Barcelona and Amsterdam. While research indicates that tourism is relatively elastic and that tourists are highly price-sensitive (Aguilo, 2005), for cities such as Venice where a price increase creates a relatively small increase in the total cost, tourism has proven to be inelastic (Bonham, 1992). In the short-term, Venice will unlikely experience significant changes in overall tourism numbers due to the inelastic demand of its tourism sector. This proposal suggests that Venice can work towards a more sustainable tourism level by utilizing a tax system, but these taxes are primarily viewed as a revenue source for climate change adaptation techniques and repairing damages from overtourism.

CLIMATE CHANGE ADAPTATION

The tax revenue collected from the hotel and day trip taxes should be allocated towards adaptive climate measures to combat the impacts of sea-level rise and flooding including salt marsh restoration and building maintenance to help ensure the long-term sustainability of Venice.

Venice's natural environment surrounding the lagoon has long-served as a natural barrier against erosion, as well as a crucial part of the tidal ecosystem. In recent decades, it has drastically been reduced from 170 square kilometers in 2003 to 47 square kilometers in 2019 (C40 Cities, 2018). Continued development, such as excavation of deep channels for large tourism cruise ships, has accelerated erosion on the Venice lagoon. In September 2013, Venice and the EU partnered with the University of Padua's in cultivating the LIFE VIMINE salt-marsh restoration pilot (Figure 2). This project provides a multitude of benefits including reducing erosion from cruise ships and sea-level rise, rebuilding natural ecosystems and biodiversity and serving as a natural flood prevention mechanism to protect the city.

FIGURE 2.

Salt-marsh restoration surrounding the Venetian Lagoon through the LIFE VIMINE pilot

To encourage its continuity, we propose allocating funds from the tourism tax revenue to expand the pilot into a continual program that creates new local jobs and economic activity as well as a network for tourism and environmental sustainability to work cohesively. We also suggest using this increased financial resource to expand the program, for example, by installing permeable breakwaters which will enhance revegetation and reduce wave generation (Day, 1998). Additional measures may include raising and protecting specific sections of the lagoon bed in the inlet channels by constructing breakwaters to the south of the inlets so as to reduce wave height, which will reduce tidal levels in the lagoon (Munaretto 2012). Funding from the tourist taxes should be allocated to continue to protect and grow the salt marshes in Venice, protecting the lagoon from erosion and reducing flooding.

Venice's historic infrastructure continues to suffer from flood damage, with recent floods resulting in over a billion euros in damage costs (Zampono, 2019). Structural degradation is incurred by the rising water levels driven by climate change and the displacement of large cruise ships in the canals (Cooper, 2019). This damage is widespread, as the historic structures in Venice were not constructed to handle the current water levels. Local businesses and restaurants are bearing the financial burden flooding induces. In many instances, damage repairs are beyond what owners can afford, upwards of 35,000 euros, so many shut down (Legorano and Sylvers, 2019).

To provide immediate relief, we suggest allocating a portion of the revenue generated from the tourist taxes to reparation costs for historical buildings and public and private buildings for damages caused by flooding. This will increase the stability of Venice's building stock and incentivize business owners to remain active members of the local economy. To encourage local investment, these funds will have local workforce hiring requirements. These stipulations ensure that all funds expended from tourism tax revenue will create new jobs and opportunities in Venice, which will ameliorate potential losses that may result from a decrease in the overall tourism industry due to additional taxation.

FUTURE CONSIDERATIONS

In addition to hyper-local adaptive solutions, Venice should also consider long-term mitigative strategies to ensure the resilience of Venice in the face of climate instability for future generations. We recommend the development of an Independent Commission to manage more large-scale resiliency projects such as the MOSE seawall system. This commission will be governed by an advisory board drawing from government agencies, community advocacy groups and experts in science and policy. There are potential infrastructure projects that current research suggests may be applicable, such as:

Raising the City -Venice pumped its shallow groundwater in the mid-1900s, which led to the compacting of the sediment underneath the city, leading to a drop of the total city of 15 centimeters. One possible solution to gain back this important height is to pump water back underneath the city, raising the city by potentially 25-30 centimeters. This proposed solution requires 12 injection wells placed in a ring around the city, continuously pumping seawater for a period of 10 years (Teatini et al., 2011). This proposal suggests that by varying the pumping rates, a uniform uplift can be maintained across the city.

MOSE 2.0 - As the MOSE system lifespan is estimated to be 30-50 years due to the rising sea levels from climate change, Venice will need a new long-term solution to ensure the long-term protection of the city. There are various examples across the world of potential solutions, such as Rotterdam's Maeslant Barrier, which was completed in 1997 and cost 450M Euros to build (Bentley, 2015). However, as Venice requires the closure of three separate entrances to the lagoon, this will likely require a multi-decade infrastructure project.

New Cruise Port - While Venice's legislation diverts cruise ships larger than 55,000 tons after 2021 from the St. Marks port, no construction has been undertaken to allow this law to be enacted. Venice's politicians have suggested cruise ships dock at nearby industrial ports as a more effective long-term solution is to build a new port outside of the lagoon, which would require transportation infrastructure from the entrance of the lagoon to the city.

CONCLUSION

Climate change has irrevocably changed the relationship between Venice and the water from which it draws its lifeblood. Rising sea levels and flooding have caused unprecedented damage to the city and threaten its very existence. This has been exacerbated by overtourism, which has further subverted Venice's ecosystems and the foundational structures of the city, driving residents out from the heart of Venice.

To ensure the sustainability of Venice, this policy proposal recommends leveraging tourism taxes to fund adaptive climate change measures while simultaneously driving down tourism levels. This strategy will help Venice find an equilibrium tourism level while ensuring the city remains sustainable, resilient and above water for future generations.

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ADDRESSING CLIMATE CHANGE RESILIENCE IN WOLLONGONG

Written by: Melissa Brill, Talia Gerstle, Matthew Roy, Ricardo Saraiva, and Radhika Sundaresan

EXECUTIVE SUMMARY

As Wollongong, Australia continues to face increasing threats from climate change, it is imperative that the city adopts stronger resilience measures to protect and support its citizens.

This memo is based on a framework that highlights the importance of building social capital in a community to ensure that community leaders are engaged in all initiatives. The first key policy recommendation that stems from this framework is to improve dissemination of information to ensure the safety and well-being of Wollongong's citizens before, during, and after a crisis. The second key policy recommendation is to develop an insurance policy that focuses on protecting the most at-risk populations.

BACKGROUND

Wollongong is a coastal city 30 km from Sydney in south-eastern Australia. within 60km of coastline (Maps, 2020). It has a population of approximately 300,000 people, and 15% live below the poverty line (Mapping Economic Disadvantage in NSW Report, 2019). Three critical populations that are especially vulnerable to climate induced risk factors are the elderly, disabled populations, and those living below the poverty line.

The primary economic sectors are education, mining, heavy industry, fishing, tourism, and health. The University of Wollongong is an internationally renowned institution and has strong research facilities in climate change.

A report released in 2013 by the University of Canberra about climate risks in SE Australia reported that the largest climate risks to Wollongong are bushfires, coastal flooding, erosion, heat, extreme weather, and landslides. A risk assessment conducted in 2010 by the Wollongong City Council found that there will be 947 land parcels in Wollongong that are at risk of coastal hazards by 2100. Furthermore, the 2013 University of Canberra report suggests that fires and rainfall will increase in severity due to climate change. In addition, the frequency of very high and extreme fire danger days is likely to rise by 4-25% by 2020 and 15-70% by 2074. Severe bushfires followed by heavy rainfall will lead to increased debris flows and mud slides following the event.

Wollongong is located in the Illawarra region; this region has an average of 760 bushfires per year, and 4-5 of these are deemed "major fires," as identified by a report conducted by the Illawarra District Bush Fire Management Committee (2008). The principal causes of fires are: arson and incendiarism, car dumping, lightning, electrical power lines, escapes from legal burning, and illegal burning activities. The Illawarra District Bush Fire Management Committee report identified the following assets as the most at risk due to bushfires: human settlement, economic, environmental, and cultural (2008).

CURRENT STATUS:

I. GENERAL

The Wollongong City Council has already undertaken a number of initiatives to focus on climate resilience. This includes the following: a significant program of bushland works, a major weed and pest management program, management plans for major estuaries, and stormwater levy funding to finalize stormwater management plans. For this reason, this memo does not focus on these plans, though they are important.

In 2009, the city commissioned a Climate Change Risk Assessment Study and a Climate Change Adaptation Strategy and Action Plan (Norman, 2013). This study identified the key risks and actions to help manage them. In 2012, they published an Environmental Sustainability Strategy (Climate Change Adaptation Strategy and Action Plan, 2009). Also commendable, in 2017, Wollongong joined the Global Covenant of Mayors for Climate and Energy. Through this covenant, they finished a climate change vulnerability assessment and are currently conducting a climate change hazards assessment. As part of their involvement, they will develop a climate change adaptation plan in their third year (Wollongong City Council, 2012).

II. ACCESS TO INFORMATION

Currently, the city of Wollongong and the New South Wales (NSW) government websites have large data sets and information sections on bush fires caused by climate change and other means (2020). These contain data on fire management schemes, average temperatures in the region over time, and advice for evacuation plans in the event of dangers such as fires. While it is beneficial that the areas already have adequate access to information, the information is not presented in an easily accessible manner for the community.

The websites are heavy with information, making them especially difficult to use in times of distress and danger. In addition, the websites are fairly outdated; most pages were created up to and over a decade ago. Finally, this information is inaccessible to the people who either do not have access to the internet, or who need assistance to access the internet when making plans and evacuating.

NSW also has a website and a free phone app called 'Fires Near Me NSW', available to download by the public (n.d.). The app allows users to receive live updates of fire events near them and the degree of danger they may be in at a specific location. Currently the app has no features to disseminate information related to fire evacuation plans, inform the public of local air quality, or recommendations for community engagement to increase social capital and resilience.

POLICY RECOMMENDATIONS:

I. BUILD SOCIAL CAPITAL

Building social capital in Wollongong is the first recommendation because it is one of the most effective ways to build resilience in a community and will enable success of this memo's other recommendations. Wollongong should utilize the existing network of people who are already influencers within the community. For example, they should get the support of leaders of schools, community centers, faith-based centers, neighborhood associations, and health centers who can help foster trust within communities. Community focus groups with these leaders and others could help develop community-specific programs to help disseminate information, such as the phone application discussed in the following section. This will also facilitate ownership among people in the community to help during times of distress. It would also be beneficial to collaborate with the Center for Human and Social Capital Research at University of Wollongong Australia to formulate effective ways to build a stronger network.

For the community network to stand the test of time, contextualizing this knowledge flow through a structured curriculum at the school level will aid students to develop fire risk plans and other solutions to climate risks in the future, other than just the transfer of knowledge. This could attract visibility to the issue and could further expand to a greater subset of the population.

Lastly, Wollongong should create an information-sharing management portal. This would provide residents with a way to tell other members of their community if they would be able to evacuate themselves during an emergency or if they would require assistance for themselves and their families. Though this portal should not be mandatory to participate in, it should be widely publicized and encouraged by community leaders.

II. PHONE APPLICATION AND DATA DISSEMINATION

The NSW and Wollongong government websites do contain useful information, however there is great potential in improving the app to increase the resilience of local communities to the impacts of fires. Prior to the following recommendations, all information that is not currently up- to-date should be updated where possible. The NSW and Wollongong website data should be synthesized and added to the current 'Fires Near Me' app to make the information more easily accessible. Specific app page additions include:

Live air quality

- The city of Wollongong should install air quality monitors. These could collect data which could then be transferred as a live feed to the app, allowing residents to see areas with 'safe', 'moderate', and 'unsafe' air quality, with recommendations to stay inside or evacuate where appropriate. There should also be a 'send data' section, whereby residents can upload images or statements to inform others of live updates to the air quality other than fires, such as traffic pollution and associated smog. A similar project to base these changes on exists in China. The 'Blue Map' provides residents with local air and water quality; it has been successful in increasing the knowledge and resilience of the local communities (Araos, 2016).

My fire plan

- The fire plan advice from the current websites should be added to the app in a concise way. This will equip residents to take necessary steps both during and following a fire.

- A report from the International Journal of Wildland Fire stated that the key aspects of a bushfire survival plan include coming up with roles for all individuals in the household, multiple contingency plans, and triggers for action (such as social media, visual cues, etc. Further, a study conducted during the 2012/2013 fire season found that only 12% of citizens in New South Wales have a written plan, 62% have a mental plan, and 27% have no plan (Eriksen et al., 2016).

Vegetation management guide

- The 10/50 vegetation management guide currently exists on the NSW government website and is reasonably straightforward. Thus, this information should be transferred to the app to engage more residents with effective tools to clear vegetation.

Monitor Landslides

- The University of Wollongong has created a GIS based Landslide Inventory of the Wollongong local government area (Eriksen et al., 2016). Currently, four landslide sites are fully monitored, and the university plans to send across the data to emergency response organizations and utility managers for them to monitor and act immediately. This network of real time, web-enabled landslide monitoring stations could be expanded across the boundaries of Wollongong to track the possibilities of landslides.

Finally, it is important to ensure that local government officials are utilizing and have access to the information on the application. In addition, access to the internet and electricity may be limited during a disaster. Hence, to facilitate transfer of essential information (mentioned in the apps), the social capital created through community networks will help bring in the necessary action required through human intervention during and following a disaster.

III. INSURANCE

The City of Wollongong should consider a program designed to ensure that low-income individuals living in high-risk areas of Wollongong have access to affordable and comprehensive property insurance (University of Wollongong Australia , n.d.). This program should cover three critical areas:

1) creation of mandatory minimum property insurance standards in Wollongong,

2) development of a city-subsidized insurance assistance program, and

3) partnerships with development firms to build high-density low-income housing.

This program would drastically enhance community capacity to recover following a natural disaster. Climate change is steadily increasing the probability of natural disasters such as flooding, landslides, and bushfires in Wollongong. As these events continue to occur, low- income families living in high-risk zones will fall victim to their lack of insurance, underinsurance, or inability to afford future premiums following disasters (Blanchi, 2018). The Wollongong City Council should work in tandem with the NSW Land Registry Service to ensure that high-risk properties are properly insured by imposing city-regulated minimum insurance standards for these high-risk properties. This program could be similar to the flood insurance mandate in the United Kingdom that requires applicants to obtain flood insurance during a mortgage application (Penman, 2016). This system is maintained via a collaborative arrangement between insurers and governmental bodies. Insurers provide affordable policies in exchange for the government taking appropriate mitigation actions. The first step in any recovery effort should be the proper compensation for lost assets; Wollongong can make a significant impact by mandating minimum insurance standards.

However, simply mandating minimum insurance standards would not address the problem of insurance affordability in Wollongong's low-income communities. As such, the City of Wollongong should develop an insurance assistance program to subsidize property insurance premiums for low-income residents (Paudel, 2012). The City of Wollongong, by creating minimum insurance standards and subsidizing premiums for low-income residents, can help relieve the insurmountable financial burden of recovery in low-income communities. However, it is critical to acknowledge that the end goal is to move residential properties out of these high-risk zones. Research has shown that long-term subsidized disaster insurance is associated with disproportionate support from wealthy coastal property owners while also encouraging development in high risk areas (Strahan, 2018). As such, it is advised that insurance assistance programs include a sunset provision that would eventually require residents to leave high-risk areas and relocate to the lower risk communities.

Finally, the City of Wollongong can reduce the financial costs of these insurance minimums and programs by distributing the cost through high-density, low-income housing developments. We believe that there is opportunity for the city to partner with development firms to build higher-density, low-income housing in lower risk areas of Wollongong. This could be accomplished through tax increment financed, city buybacks of high-risk, low-income properties and sale of other government owned land parcels in lower-risk areas to developers where low- income housing is a condition of the transaction. Encouraging high-density, vertical development would help increase opportunities for social capital development in these communities which would improve post-disaster recovery (Aldrich, 2011). Furthermore, high-density developments present an opportunity to spread insurance premium costs among many residents of the same structure, as opposed to a structure-by-structure purchasing scheme found in low-density areas This premium is the improvement of the land where new units are built.

IV. ADDITIONAL RECOMMENDATIONS

In the event of a disaster, power lines, internet access or phone signals may be limited or unavailable. Thus, asset maps should be printed and displayed in specific community focus points such as schools, hospitals, and community centers. They should contain information regarding physical, economic and institutional assets, such as buildings, transportation sites and what residents produce and consume in the community. This will allow citizens to create evacuation plans and help others, increasing resilience to climate change impacts.

CONCLUSIONS:

In the long term, there must be buy-in from the community and the government to implement the creation of a city-subsidized insurance program. The phone application and community networks will equip the public with necessary information to prepare, act, and help one other both during and following a disaster. The unique characteristics of Wollongong should be taken into account by state agencies to facilitate implementation of the recommendations. The interventions proposed will help tackle the vagaries posed by climate change in Wollongong more effectively and enhance community resilience as climate change presents increasing challenges.

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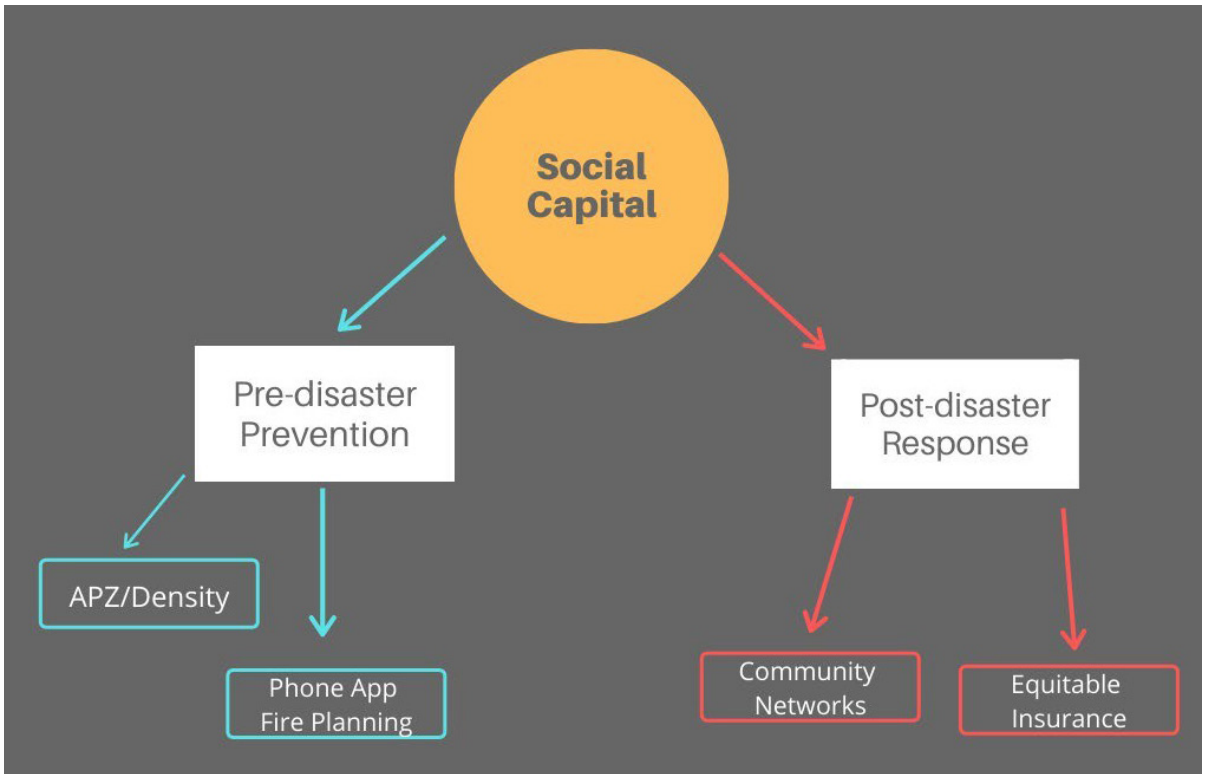
APPENDIX

MAP 1:

FIGURE 1:



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APPENDIX 1: AGENDA

FRIDAY, FEBRUARY 28TH, 2020

12:00 - 1:30 PM **Lunch and Informational Meeting at Arcadis** *(Optional)*

1:45 - 3:30 PM **Social Equity in Urban Resiliency Planning Trek** *(Optional)*

Visit 4 climate change-affected areas in the Southwest side of Chicago for a trek that will explore the policy and practical implications of urban resiliency planning in low-income communities and communities of color. Participants will learn from a government consultant who is experienced in urban resiliency planning and emergency management at the local and county level.

3:45 - 5:00 PM **Visual Communication Strategy Workshop** (*Optional*)

4:00 - 5:00 PM **Keller Building Tours** (*Optional*)

5:00 - 5:30 PM **Registration**

5:30 - 5:35 PM **Opening Remarks**

Katherine Baicker, *Dean of the Harris School of Public Policy*

5:35 - 6:00 PM **Keynote Remarks**

Malu Blázquez, *Executive Director, ReImagina Puerto Rico*

6:00 - 7:15 PM **Panel Discussion**

Greg Gershuny, *Executive Director of the Aspen Institute Energy and Environment Program (moderator)*

Malu Blázquez, *Executive Director, ReImagina Puerto Rico*

LeeAnn Tomas-Foster, *Big Urban Client City Executive with Arcadis*

Allison Arwady *(CLA'18), Commissioner, Chicago Department of Public Health*

Jeb Brugmann, *Founding Principal, Resilient Cities Catalyst*

7:15 - 8:30 PM **Reception**

8:30 - 9:00 PM **Dinner for Participants & Speakers** (Sky Suite)

SATURDAY, FEBRUARY 29TH, 2020

8:00 - 9:00 AM **Breakfast & Coffee** (Sky Suite)

9:00 - 10:30 AM **Session I** (Sky Suite)

Participants will divide into groups, each representing one city of interest for initial brainstorming and research

10:30 - 10:45 AM	**Coffee Break**
10:45 - 12:00 PM	**Session 1** *continued*
12:00 - 1:00 PM	**Lunch** (Sky Suite)
1:00 - 2:15 PM	**Session II** (Breakout Rooms) Participants will engage in more focused research and begin working toward the creation of their policy memo and presentation in separate rooms.
2:15 - 2:30 PM	**Coffee Break**
2:30 - 4:15 PM	**Session II continued**
4:15 - 4:30 PM	**Coffee Break**
4:30 - 6:30 PM	**Roundtable Discussion** *(Sky Suite)* ***Moderator***: **Greg Gershuny,** *Executive Director, Aspen Institute Energy and Environment Program* Each group will present a 5-minute summary of their findings to date and then the whole group will discuss.
6:30 - 8:00 PM	**Dinner at the Pub** (Ida Noyes Hall basement, 1212 E 59th St)

SUNDAY, MARCH 1ST, 2020

8:00 - 9:00 AM	**Breakfast & Coffee** (Sky Suite)
9:00 - 10:30 AM	**Session III** (Breakout Rooms) Groups will work to make final preparations for their presentation and continue work on their policy memos.
10:30 - 10:45 AM	**Coffee Break**
10:45 - 11:30 AM	**Session III** *continued*
11:30 - 12:30 PM	**Lunch** (Sky Suite)
12:30 - 3:00 PM	**Final Presentations** (Sky Suite)
3:00 - 3:15 PM	**Coffee Break**
3:15 - 4:45 PM	**Session IV** (Sky Suite/Breakout Rooms) Groups will make revisions based on presentation comments and questions.
4:45 - 5:00 PM	**Closing** (Sky Suite)

APPENDIX 2:
PARTICIPANTS AND BOARD MEMBERS

PARTICIPANTS

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