Urban Policies for Climate Action: Risk Assessment and Impact Inequality

APPAM International Conference
London School of Economics
June 13-14, 2016

Abstract

At the current rate of urbanization, 87% of the population of Latin America will live in urban areas within the next 30 years. Mid-sized cities, or emerging cities, will face new challenges in the management of municipal services as the population growth rate surpasses that of the region’s largest cities. Focused in the city of Florianópolis, Brazil, this research explores sustainable urban development by analyzing growth patterns and historical changes in local policies and planning practices that affect vulnerable populations. In relation to the potential effects of climate change, coastal cities are vulnerable to sea level rise and extreme hydroclimatic events that can result in flooding. Such events can strain the ability of local governments to implement disaster response protocols that safeguard human welfare as well as protect critical infrastructure. This research strives to identify leverage points that work towards sustainable urban development without exacerbating deficiencies in the availability of public goods and basic services or worsening social inequality through the unequal distribution of the costs and benefits of environmental change. Despite efforts to develop inclusive policy, it remains an enduring challenge to identify windows of opportunity for the development of policies that can both address the profound daily hardships endured by marginalized populations as well as global priorities such as climate change mitigation.

1. Introduction

Brazil has the fifth largest population globally and the seventh largest economy. Of the total population of Brazil, 85% are already living in urban areas (World Bank, 2016). The urban growth rate is highest in mid-sized cities, or emerging cities \(^1\) (Martine & McGranahan, 2010; IDB, 2014). In 1980, Brazil had 42 cities with a population between 200,000-1,000,000 and 10 cities with over 1 million people. In 2010, there were 138 cities with a population between 200,000-1,000,000 and 14 cities with over 1 million (IBGE, 2016). As a result, mid-sized cities

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\(^1\) Mid-sized cities are defined by the Inter-American Development Bank (IDB) to be cities with populations between 100,000 and 2 million people.
are facing new institutional challenges in the management and provision of municipal services. Sustainable urban planning has become the normative development standard among global multilateral organizations, transnational financial and non-governmental institutions and multi-level community associations. New modes of planning seek to minimize carbon intensive, resource depleting, or hazardous urban practices and encourage practices designed to reduce the ecological impact of urban expansion and promote equitable economic growth.

The degree to which cities have been able to alter path dependent business-as-usual practices and transition to practices intended to support long term environmental and economic sustainability varies significantly worldwide. Urban Climate Action Plans and Climate Adaptation Plans are taking on grander and more visionary scales in global cities such as New York City, London and Rotterdam as well as developing nation cities such as Quito, Ecuador and Durban, South Africa (Carmin, Nadkarni & Rhie. 2012; Gallucci, 2013). However, individual cities are subject to a unique constellation of internal and external pressures intended to influence how trade-offs are made. Sector specific policies, plans and projects intended to move development toward sustainability are also designed and implemented based on particular urban characteristics and needs. As the importance of context cannot be understated, case study methodology is a useful and appropriate tool for exploring the dynamics of sustainability transitions.

One aspect of urban sustainability is the ability of an urban system to be resilient to natural disasters, the frequency of which is predicted to increase as a result of climate change (IPCC, 2012). This paper is a vulnerability analysis which is part of a larger research project focused in the city of Florianópolis, Brazil. The larger project explores the ways in which municipal planning institutions in a rapidly growing mid-sized city engage with modes of
governance that guide transition toward practices that improve the overall sustainability of the urban system. This paper specifically addresses risks related to natural disasters in the urban area and the institutional mechanisms that seek to minimize, prepare for and respond to such events. The primary research questions pertaining to this specific area are: (1) What geological or structural characteristics of the Florianópolis area increase vulnerability of the population to natural disasters? (2) What socio-economic characteristics exacerbate these vulnerabilities and create inequalities in exposure? (3) To what extent and in what way are municipal institutions addressing risks associated with natural disasters? The article concludes with policy recommendations and suggestions for future research.

2. Background

2.1. Transnational Standards

In 2015, the United Nations General Assembly adopted the post-2015 development agenda, “Transforming our world: the 2030 Agenda for Sustainable Development” (2015). The Sustainable Development Goals (SDGs) are the newest face of a development ethos, built on a half century of efforts to consolidate support, that seeks to correct what has come to be viewed as unsustainable development that favors the economic imperative over social and environmental (Hedigar, 1999; IUCN, 1980; Mazmanian & Kraft, 2009; Neumayer, 2003; UN, 1992; WCED, 1987). Under the banner of sustainability and sustainable development, climate change is stressed as a threat and one of the greatest challenges in achieving the SDGs. Among the 17 SDGs, and the associated 169 targets, set forth in the agenda are the goals to make cities “inclusive, safe, resilient and sustainable” as well as to increase the share of renewable energy in the global energy mix, combat climate change, and protect terrestrial ecosystems (UN General Assembly, 2015).
Evaluating urban sustainability often begins by reviewing a comprehensive set of indicators in the following sectors: sustainable construction and infrastructure, governance, mobility, housing, opportunities, planning and land management, services and equipment, environmental issues, urban safety and social inclusion (IDB, 2014; Leite, 2012). The Emerging and Sustainable Cities Initiative (ESCI) of the Inter-American Development Bank (IDB) developed an approach that identifies the following three dimensions of urban sustainability: environmental sustainability and climate change, comprehensive urban development, and fiscal sustainability and good governance (IDB, 2014). The first dimension, environmental sustainability and climate change, encompasses several aspects of development including: environmental management and natural resource consumption, mitigation of greenhouse gases and other pollutants, and reduction of vulnerability to natural disasters and adaptation to climate change.

The study at hand focuses narrowly on the last facet by evaluating how the municipal government of Florianópolis has engaged with issues of vulnerability through various means such as risk assessments, regulations to control urban development in high risk areas, monitoring and enforcement of zoning restrictions, development of anticipatory planning, and development of disaster response protocols. Climate vulnerability refers to the likelihood a climate hazard will occur, the severity of the hazard, and the resources a person has available to them to cope with the effect (Schensul, 2015). Analyses of the causes of vulnerability include infrastructure and geological assessments as well as institutional, social and economic factors.

2.2. The Local Context

By most accounts, climate change is already contributing to the erosion of coastal zones and increasing the incidence and intensity of natural disasters in addition to threatening food
security and increasing the spread of vector-borne illness (UNFCCC, 2007). Coastal cities are particularly vulnerable to the effects of sea level rise and hydroclimatic events. A study conducted by the Economic Commission for Latin America and the Caribbean (ECLAC) suggests the cumulative cost of extreme climate events in the Latin American and Caribbean region could reach USD 250 billion by 2100 (2009).

Local level governance institutions, particularly in rapidly growing mid-sized cities, can improve resilience to natural disasters by identifying vulnerabilities and developing long term action plans and policies that can guide the trajectory of urban development in ways that mitigate potential social and economic impacts. The operationalization of resiliency requires the ability to anticipate hazards, reduce vulnerability of the population to hazard events, prepare disaster response protocols for efficient emergency response, and put in place mechanisms for supporting medium and long term recovery (Colten, Kates, & Laska, 2008).

In Brazil, the National Secretariat of Civil Defense (SEDEC) is the central office of the National Civil Defense System (SINDEC) and is responsible for coordinating action to mitigate and respond to disaster events. In 2005, by official decree (Decree 5376/2005), there was a restructuring that established SINDEC as an entity composed of representatives of government ministries in the National Council of Civil Defense (CONDEC) as well as regional coordination bodies (CORDEC), state level coordination offices (CEDEC), and municipal coordination offices (COMDEC). SINDEC has helped establish small community-based groups to foster public awareness and train individuals in disaster reduction. In 2010, the Florianópolis COMDEC was established complementary to an existing State Law (1178/73). The Municipality of Florianópolis passed a law (Complimentary Law No. 370/2010) creating the Directorate of Civil Defense in the same year with the aim to guarantee the right to life, health, public security
and safety of persons and property during disasters. Additionally, the National Secretariat of Civil Defense (SEDEC) together with the University Center for Disaster Studies at the Federal University of Santa Catarina (CEPED, UFSC) has trained over 2,000 people in the Florianópolis area in Basic Training for Civil Defense (CEPED, 2012). In 2012, the Federal Government launched the National Plan for Risk Management and Disaster Response which is a coordination between various government agencies to produce risk maps and geotechnical research, support prevention planning, and install monitoring equipment.

The Florianópolis Action Plan (2015), developed in coordination with the IDB, identified a need for increasing resilience to disasters in the urban region and promoting adaptation. The Emerging and Sustainable Cities Initiative (ESCI) methodology of the IDB involves a rapid assessment of sustainability indicators which enables governments of emerging cities to quickly prepare action plans based on identified needs, fiscal capacity, and citizen demand (IDB, 2014).

The Florianópolis Action Plan prioritizes three strategic lines: sanitation management, urban territory and mobility, and technological innovation in public administration. The promotion of energy efficiency and renewable energy was highlighted in the report as a cross-cutting issue. In promoting synergies between strategic lines, the second priority area includes the following objectives: develop and implement projects defined in the revised Municipal Plan for Risk Reduction (SMHSA, 2011), identify strategic segments of the power grid that are vulnerable to windstorms and transition to an underground distribution network, develop and implement an institutional development plan for the municipal civil defense system, develop a plan for sustainable management of floodplains, and implement a coastal ocean monitoring system. In addition to the Directorate of Civil Defense, municipal bodies that are involved in meeting the above objectives include the Department of Housing and Environmental Sanitation, the Institute
for Urban Planning of Florianópolis (IPUF), the Municipal Foundation for the Environment (FLORAM), and the electric utility of the State of Santa Catarina (Celesc).

3. Case Study: Florianópolis, Brazil

3.1. The Study Area

Florianópolis, the capital of the state of Santa Catarina, ranks third among Brazil’s 5,565 municipalities in terms of human development according to the Municipal Human Development Index (MHDI, 2010). The 2010 population was 421,240 with 877,116 in the greater metropolitan area and projections indicate the population will grow to a 2050 population of 734,805 with 1,566,067 in the metropolitan area (IDOM-COBRAPA, 2013a). As such, the region has attracted skilled labor which has helped consolidate Florianópolis as a technological and innovation hub. In addition, with a large part of the municipal territory located on the island of Santa Catarina, the city experiences intense pressure on infrastructure and municipal services during the tourist high season.

3.2. Methodology

This evaluation is based on a systematic analysis of secondary sources, such as vulnerability assessments, historical accounts and planning documents. Particular attention is paid to local level governance institutions in the Florianópolis area and the development of tools and mechanisms for the management of vulnerability and risks germane to hydroclimatic events. Secondly, semi-structured interviews were used to verify and enrich information obtained from secondary sources. Interviews were conducted with key informants from municipal departments and community organizations as well as with real estate developers. Institutional planning practices for the management of risk associated with natural disasters in the Florianópolis
metropolitan area are analyzed to determine what historical influences have led to the institutionalization of disaster preparedness and response protocols.

3.3. Vulnerability Assessment

Vulnerability analysis often incorporates the use of reduced form models. In presenting a framework for vulnerability analysis aimed at advancing sustainability, Turner et. al. (2003) present a comprehensive vulnerability framework which distills the primary components and linkages that constitute a human-environment system’s vulnerability to hazards. While models often focus explicitly on exposure and sensitivity to stressors, they are limited in their ability to provide insight into “(i) the ways in which the systems in question amplify or attenuate the impacts of the hazard; (ii) the distinctions among exposed subsystems and components that lead to significant variations in the consequences of the hazards; and (iii) the role of political economy, especially social structures and institutions, in shaping differential exposure and consequences” (Turner et. al., 2003, 8074).

This study attempts to address such limitations of the modeling approach by complementing existing risk analyses with qualitative data reflecting the ways in which the Florianópolis Municipality has sought to evaluate risk and institutionalize disaster preparedness, response and recovery systems. Based on a narrow field of sub-sections in the framework developed by Turner et. al. (2003), this analysis is organized by evaluating vulnerability in terms of exposure (characteristics and components of exposure), sensitivity (human conditions, environmental conditions, and their interactions), and resilience (responses to disaster events including coping, impact, and adaptation). The ways in which vulnerability analyses have been linked to decision-making in policy and planning arenas are then assessed.
4. Discussion

4.1. Exposure to Risk

In addressing the first line of inquiry (*What geological or structural characteristics of the Florianópolis area increase vulnerability of the population to natural disasters?*) the particular geophysical characteristics of the study area were reviewed. Several quantitative analyses of vulnerability and risk in the Florianópolis area have been completed (IDOM-COBRAPE, 2013b; SMHSA, 2011; CEPED/SMHSA, 2007). A technical report conducted by the IDOM-COBRAPE (2013b) consortium, supported by the IDB, evaluated the primary natural hazards present in the nine municipalities of the Florianópolis metropolitan area. In addition to the analysis of the natural hazards, the study estimated the associated disaster risks by measuring the probability of event occurrence and the projected economic and human impact. The primary identified risks are the result of river flooding, coastal flooding and landslides.

Using a digital terrain model (DTM) with a spatial resolution of one meter, rivers prone to flooding as well as possible variations in rainfall and temperature changes that may occur in climate change scenarios were identified. In order to study coastal flooding in Florianópolis the statistical model Delft3D, developed by Delft Hydraulics, and the RFSM-EDA (Rapid Flood Spreading Method - Explicit Diffusion wave with Acceleration) models were used. The maps below represent the results for two scenarios: the least expected impact over a 10 year period with current climate conditions (Figure 1) and the greatest preojected impact over a 200 year period with an average sea level rise of one meter (Figure 2). Results indicate that current urbanization trends are affecting watershed hydrology and leading to an increase in impervious

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2 The urban area includes the nine municipalities of Águas Mornas, Antônio Carlos, Biguaçu, Florianópolis, Governador Celso Ramos, Palhoça, Santo Amaro da Imperatriz, São José e São Pedro de Alcântar.
areas thereby hindering the infiltration of rain water. Estimates suggest more than 150,000 people are vulnerable to flood events (IDOM- COBRAPA, 2013b).

*Figure 1 Impact over 10 year period*  
*Figure 2 Impact over 200 year period*  

These areas projected to be impacted by flooding can be compared to projected urban growth trends in Figure 3 and Figure 4 below. The most significant challenge related to long term planning to reduce exposure to risk is the redirection of these growth trends. In the coastal areas, vulnerability to flooding and erosion has not been adequately incorporated into management structures.

Source: IDOM/COBRAPE, 2014
Stabilization of shorelines and reduction in the impact of natural disasters can be aided by strategic land preservation regulation of mangroves. Mangrove systems are rich in marine biodiversity and ecosystem services (Magris & Barreto, 2010). Naturally prone to flooding and characterized by soil that is problematic for construction, they are already protected areas under the existing legal framework of Brazil as well as the Municipal Master Plan of Florianópolis. Additionally, land use regulations are in place to restrict development along channels and rivers, the width of preservation depends on the drainage basin and varies from 33 to 120 meters on each side. The Federal Constitution of 1988 (Art. 20) preserves a band of land along the shore 33 meters wide from the average high tide level. Enforcement of existing development restrictions in these areas will help reduce urban growth in flood prone areas.

In addition to preventing development in high risk areas, implementation of a monitoring system of coastal dynamics is a common technique for reducing exposure to natural disasters. Continuous measurements of tidal changes as well as morphological changes in the shoreline catalogue the magnitude of changes and indicate need for mitigation measures. While the
Department of Geosciences at the Federal University of Santa Catarina is installing monitoring equipment with assistance from the National Scientific and Technological Development Council (CNPq) and the Inter-Ministerial Commission for Sea Resources (CIRM), there is a need to establish more monitoring sites and clear channels of communication to municipal institutions so as to ensure city managers benefit from collected data (IDOM-COBRAPE, 2013b).

4.2. Sensitivity to Risk

The second line of inquiry (What socio-economic characteristics exacerbate these vulnerabilities and create inequalities in exposure?) is explored by reviewing the ways in which human conditions in relation to environmental conditions create inequalities in the degree to which communities are impacted by natural disasters. In reference to vulnerability to landslide risks, the Institute for Technological Research (IPT) conducted a study in 2013 in accordance with the standards of the Companhia de Pesquisa de Recursos Minerais (CPRM), a state-owned company that carries out the Geological Survey in Brazil. This study found the primary populations vulnerable to landslide risk were informal settlements built on slopes and hills. Although formal construction is restricted in these areas, it is common for lower income groups to acquire lots in these areas. As these settlements typically have inadequate access to basic services and urban infrastructure, poorly managed sewer water, particularly during periods of inundation, can trigger landslides. In addition to greater vulnerability as a result of topographical characteristics, these settlements are often poorly constructed making the potential for damage greater. The IPT report suggests there are 120,000 people living on landslide prone slopes in the Florianópolis area (IDOM-COBRAPE, 2013b). Although there are regulations restricting construction on slopes with a 20° incline, and prohibition on building on steeper inclines, there is poor information and monitoring of these regulations. Regularization of
informal settlements has begun under the direction of SMHSA. One settlement in the area of Serrinha, San Jose, provides an example of how resident associations are working with municipal managers to survey land and register over 400 households in a high risk area.

While restricting growth in high risk areas with a low population concentration is a low cost planning instrument that can result in considerable saving over the long term, the regularization of existing households in high risk areas can be cost prohibitive and disruptive to communities. CAIXA, a government-owned bank, has implemented several programs with the stated objective of promoting sustainable development. As a partner in the development of the Action Plan, CAIXA may provide assistance to the Municipality in support of environmental vulnerability programs. Giving low income households more housing options helps reduce land use pressure in high risk areas. CAIXA supports national housing programs including Fundo de Garantia por Tempo de Serviço (FGTS), the Fundo de Arrendamento Residencial (FAR), the Fundo de Amparo ao Trabalhador (FAT), and the PSH program (CAIXA, 2016). Families reporting a gross monthly income of one minimum wage are given priority for these programs.

In terms of economic loss related to disaster risk, the risk analysis (IDOM_COMBRAPE, 2013b) found the expected maximum loss from river flooding ranged between R$ 11 and 79 million (USD 3 to 22 million) over a period of 2 to 500 years under the current climate scenario. The expected maximum loss from marine flooding ranged from R$ 38 to 51 million (USD 10 to 14 million) over a 10 to 200 year period under the current climate scenario. With a 0.5 meter rise in sea level, this total increases to R$ 81 million (USD 22.5 million). As called for in the Florianópolis Action Plan, development of a register of land ownership and land use in areas identified as vulnerable to flooding would assist outreach activities and decrease discrepancies in knowledge and sensitivity to disaster events in these areas.
4.3. Resilience

The final line of inquiry (To what extent and in what way are municipal institutions addressing risks associated with natural disasters?) is an evaluation of the ways in which the municipality has developed protocols to respond to and recover from disaster events. In 2001, Federal Law no. 10257 was enacted supporting The City Statute which aims to regulate urban policies outlined in the 1988 Constitution and provide a legal basis for municipalities to address urban, social and municipal problems (Bassul, 2002). The federative structure in Brazil grants local governments autonomy to design policies in accordance with local priorities (Neves, 2012). As a result, municipalities are responsible for water and sanitation, territorial planning and land use.

Of the 19 municipal secretariats, as well as 17 additional municipal organs, 10 have jurisdiction related to the various facets of disaster preparedness, land use regulations, or response to hazardous events. The following municipal bodies have the largest role in enhancing preparedness and mitigating risks and were identified in the Action Plan as critical for their role in improving the resiliency of the urban system:

- Civil Defense: Develop and implement an institutional development plan for the municipal civil defense system
- Municipal Department of Housing and Environmental Sanitation (SMHSA): Develop and implement projects defined in the revised Municipal Plan for Risk Reduction
- Celesc: Identify strategic segments of the power grid that are vulnerable to windstorms and transition to an underground distribution network
• Institute for Urban Planning of Florianópolis (IPUF): Develop a plan for sustainable management of floodplains

• IPUF and The Municipal Foundation for the Environment (FLORAM): Implement a coastal ocean monitoring system

The previously mentioned re-structuring of the Civil Defense System in 2005 and the subsequent passing of laws for the establishment of local level offices in Florianópolis in 2010 is clearly an incidence in which the passing of National laws led to changes in support of sustainability at the local level. The PMRR review identified structural and non-structural interventions that should be used to reduce vulnerability in high-risk areas. Recommended interventions included the elimination of geological risks. As a result of the PMRR study, the scope of work of the local Civil Defense office was expanded (Law No. 12608/2012) in order to provide greater financial resources for personnel and equipment necessary for planned containment projects. However, disaster preparedness requires an integrated approach that demands inter-departmental coordination. Although the Office for Civil Defense is new, the other departments were pre-existing and have since added new institutional processes to accommodate the demand of new projects and inter-departmental coordination. The Municipal Emergency Fund for Civil Defense in Florianópolis (FUMDEC) was established prior to the reorganization of SINDEC in accordance with Federal Law. 4320 (1964) and is linked to the Secretariate for Municipal Security and Traffic Mangement.

As interruptions to the supply of electricity are likely during storm events, there is a need to mitigate extended power outages and the resulting impacts such as delays in the provision of emergency supplies and medical assistance as well as economic hardship. The Action Plan calls for the identification of strategic segments of the power grid that are vulnerable to windstorms
and the replacement of these segments with an underground electrical distribution network. As the cost of installing underground distribution networks is roughly 10 times higher than above ground, transitioning to protected systems will take time (Prefeitura de Florianópolis & IDB, 2015). Regional distributors have been financially impacted by the nationwide recession which could slow transition in the sector.

The primary phases in which there is a noticeable increase in the institutionalization of a disaster risk imperative in urban governance institutions were periods following changes in environmental laws and regulations at the federal level. Managerial restructuring of urban governance has occurred at various points in time as a result of improvements in quantitative and technical rationalities in disaster risk evaluation as similarly found by Béal and Pinson (2015) in their review of urban level governance in France. In the larger context of aiming to identify modes and mechanisms of institutional transformation in support of sustainability across institutional as well as social and economic systems, there is evidence of dynamic collective action in support of some sustainability goals, but not others. These differences in the degree of institutionalization appear to be the result of varying degrees of citizen concern for and knowledge of certain challenges, such as vulnerability to disaster risks.

Also important to note as occurring in the same period in which there was an increase in institutional protocols for improvements in monitoring and preparedness for disasters, as well as response mechanisms as called for in the multi-level restructuring of the Civil Defense System, was the occurrence of extreme flooding in the State of Santa Catarina in 2008. Although the flooding occurred inland from the study area in the Itajai River Basin, the extremity of the event led to state and local level interest in implementing better disaster planning. Approximately 1.5 million people were affected by heavy rains with over 50,000 people displaced, over 27,000
people left homeless, and 135 lives lost mostly as a result of landslides (Earth Institute, 2014). There was an observable increase in local level planning for such events after 2008.

5. Conclusion

As municipal level engagement with disaster planning has been evolving and strengthening, particularly over the past five years, policy recommendations for the Florianópolis area include first the expansion of technological enhancement for monitoring, and early warning systems. The risk and vulnerability assessments conducted for the study area have resulted in the generation of a rich set of data and maps that can facilitate territorial planning to reduce vulnerability. The studies assess risk based on location and frequency of events, quantify exposure in terms of infrastructure, population or property, and catalogue characteristics of vulnerable communities. While vulnerability and risk analyses intended to inform anticipatory planning have been conducted, projected patterns of urban growth continue to overlap with areas known to be vulnerable to flooding.

Secondly, strengthening coordination between municipal institutions will be critical in the event natural hazards increase in frequency or severity. Institutions will play an important role in coordinating adaptive systems in response to changing climatic conditions. As this paper presents data relevant to the ways in which various local level institutions have engaged with the topic of climate risk and vulnerability, it is clear that federal and state level Civil Defense efforts depend on municipalities to both reduce vulnerability and provide support following hazard events. Building institutional mechanisms that easily deploy support from multiple municipal organs will be critical in the success of timely, life-saving response strategies.

Lastly, the enforcement of zoning restrictions in territories determined by risk assessments to be high risk for flooding or landslides is critical. Low-income households in
urban areas, being more sensitive to natural hazards and less resilient, will face disproportionate hardships. Local level institutions are in the position to guide how urban residents anticipate and respond to environmental hazards. Suggestions for structural and managerial actions to guide development in line with geomorphological attributes, ecosystem materials, urban infrastructure needs and accessibility include zoning and regulations restricting development in flood plains, the use of flood walls, and structural improvements in areas with low flow capacity. The studies reviewed above were intended to assist planners in the development of land use planning instruments that could reduce settlement expansion in risk areas. City managers in the Housing and Environmental Sanitations Department are taking measures to address slope stabilization and prepare residents in key areas. However, vulnerability in coastal areas related to flooding and erosion have not been adequately incorporated into city management protocols, a weakness also noted in the Florianópolis Action Plan. Implementation of these management tools should be prioritized in areas that are vulnerable to flooding, but that currently have low population rates in the greater Florianópolis area.

By identifying not only general institutional capacities for responding to disasters, but also the specific ways in which local level institutions are engaging with the process of transformation to new forms of governance, policy makers can better understand why some sustainability transitions have success in the institutionalization stage and others do not. In the case of institutional change in support of disaster response, it is clear that an imperative for transition was inspired by federal laws and bolstered by nearby natural disasters. However, lulls in implementation can be attributed to budgetary constraints in the case of monitoring equipment and subterranean power lines. Availability of low-cost housing alternatives has also hampered strong enforcement of zoning restrictions which is further exacerbated by insufficient monitoring
of informal settlements in high risk areas. This research sought to identify the mechanisms by which decision making in municipal level institutions has resulted in an apparent increase in support of evaluation and establishment of institutions responsible for disaster response. While there is an apparent increase in support for mitigating risks and vulnerabilities to natural disasters, there is still a need to develop robust monitoring systems, direct growth away from high risk areas, and structure effective coordination protocols for emergency response and recovery logistics.
References


United Nations Development Program (UNDP) Brazil, Institute for Applied Economic Research


