

Governing Climate Change Adaptation Through Insurance:
Complexity, Risk and Justice Concerns?

by

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ABSTRACT

Climate adaptation has not kept pace with climate impacts which has formed an adaptation gap. Increasingly insurance is viewed as a solution to close this gap. However, the efficacy and implications of using insurance in the climate adaptation space are not clear. Furthermore, past research has focused on specific actors or processes, not on the interactions and interconnections between the actors and the processes. I take a complex adaptive systems approach to map out how these dynamics are shaping adaptation and to interrogate what the insurance climate adaptation literature claims are the successes and pitfalls of insurance driving, enabling or being adaptation. From this interrogation it becomes apparent that insurance has enormous influence on its policy holders, builds telecoupling into local adaptation, and creates structures which support contradictory land use policies at the local level. Based on the influence insurance has on policy holders, I argue that insurance should be viewed as a form of governance. I synthesize insurance, governance and adaptation literature to examine exactly what governance tools insurance uses to exercise this influence and what the consequences may be. This research reveals that insurance may not be the exemplary adaptation approach the international community is hoping for. Using insurance, risk can be reduced without reducing vulnerability, and risk transfer can result in risk displacement which can reduce adaptation incentives, fuel maladaptation, or impose public burdens. Moreover, insurance requires certain information and legal relationships which can and often do structure that which is insured to the needs of insurance and shift authority away from governments to insurance companies or public-private partnerships. Each of these undermine the legitimacy of insurance-led local adaptation and contradict the stated social justice goals of international calls for insurance. Finally, I interrogate the potential justice concerns that emerged through an analysis of insurance as a form of adaptation governance. Using a multi-valent approach to justice I examine a suite of programs intended to support agricultural adaptation through insurance. This analysis demonstrates that although some programs clearly attempted to consider issues of justice, overall these existing programs raise distributional, procedural and recognition justice concerns.

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PREFACE

I began researching relocation as an extreme form of climate adaptation. After discovering that insurance connected Kivalina, Alaska to homes along rivers in nearly all US cities and both to the huge hotel and vacation industry along the Florida coast, I realized that before I could focus on relocation I had to examine an underlying factor: insurance. Insurance stopped one of the attempts to relocate Kivalina, Alaska (Shearer, 2012) enables homeowners to live along river banks and coastlines (Cooper & Pilkey, 2012; FEMA, 2017) and enables the hotels along Florida's coastline to exist as we know them (Chassignet et al., 2017; Taylor, 2020). The three articles in my dissertation do not mention relocation anymore. However, all three provide a foundation for assessing insurance programs that are supposed to support or force relocation, for example the buy-outs under National Flood Insurance Program and Federal Emergency Management Act, insurance programs that indirectly force relocation (Suarez & Linnerooth-Bayer, 2010), and insurance programs that are intended to enable adaptation in place but may build vulnerability instead (Müller et al., 2017; Knudson, 2016). In fact, these articles will lead to both an article on insurance and relocation, and eventually prototype insurance rules which support relocation away from coasts and floodplains in a more just and equitable manner than is the case at this time.

CHAPTER 1

INTRODUCTION

Antarctic ice is melting and, even if Paris goals are met, will continue to melt (Garbe et al., 2020). Similarly, the trade-winds are already altering their course (Seager et al., 2019) and many locations around the globe have experienced extensive wildfires due to warming and drying trends of climate change (Penney, 2020). These changes are only a few in a long list of climate-caused or -exacerbated changes to the world we live in. Adaptation to these changes is not a discussion anymore. However, what climate adaptation is, how we adapt, who adapts to what and when, who pays financially, who pays emotionally, and maybe most importantly, who decides are not clear. In fact, these questions are center front in global, national, regional and local climate change adaptation discussions.

There are many actors involved in these discussions ranging from individual communities such as the Gullah/Geechee Nation in South Carolina, USA to Nation-States such as Germany, to international governmental organizations such as the United Nations Framework Convention on Climate Change Adaptation Committee to private investment holding companies such as Berkshire Hathaway and the private insurance industry to single private individuals choosing to initiate and install private adaptation measures. Some of these actors are pushing for specific forms and understandings of climate adaptation while other actors are already instituting rules that are guiding adaptation within their sphere of influence.

The answers that these various actors settle on will impact and are impacting global to local climate adaptation. Some answers will stimulate diverse creative adaptation responses while other answers may limit and even squelch adaptation responses. These impacts will also alter over time depending on mitigation and climate intervention choices. Essentially, adaptation will occur and already is occurring in a complex space and the implications need to be parsed, interrogated, understood and examined.

Those who need to make the final choices on what adaptation is, what adaptation policies to follow and who to include in the decision-making process need to understand what the consequences are of their choices. To that end, decision-makers must have information to understand the relationships between adaptation definitions and local societal values, between national and regional adaptation policy choices and on-the-ground consequences and between global adaptation choices and local adaptation choices and abilities.

This dissertation digs into the implications of one of the broad global actors impacting adaptation choices globally, nationally, regionally and locally, the insurance industry. Insurance commands trillions of USD which are being leveraged in public-private partnerships for climate adaptation and resilience. Policy- and decision-makers need to know the local implications of partnering with the insurance industry in the adaptation context. Thus, the dissertation first examines the entire 'insurance industry climate adaptation system,' its controversies and the issues and approaches that a systems approach illuminates. The dissertation then interrogates the consequences of one aspect brought forth through the systems approach, insurance as adaptation governance.

Emergence of Insurance in Climate Change Adaptation Policy

In 1995 the first conference of the parties to the United Nations Framework Convention on Climate Change [UNFCCC] took place in Berlin, Germany. One of the driving forces behind the convention was the insurance industry (Knudson, 2016; Jagers & Stripple, 2003; Leggett, 1996; Newell & Paterson, 1998). It became clear that the convention and any agreement under the convention, at that time, would not reduce greenhouse gas emissions sufficiently to avoid adaptation. Thus multiple NGOs, the Alliance of Small Island States [AOSIS] and some developing States began pushing climate adaptation through the UNFCCC process, through the creation of NGOs and various other international governmental organizations and through pilot non-profit insurance projects (Burton et al., 2002; Knudson, 2016; Jagers & Stripple, 2003; Leggett, 1996; Newell & Paterson, 1998; Schipper, 2006). The insurance industry joined this

group. However, their move to adaptation was not focused on the common good but on interconnections between investment portfolios and mitigation (Knudson, 2016; Jagers et al., 2005). By developing new forms of financial risk transfer mechanisms, insurance could avoid the controversial and financially challenging mitigation conversation and refocus on international adaptation concerns (Jagers et al., 2005).

One particularly interested International Governmental Organization [IGO] in this process was the G7 which launched InsuResilience in 2015 to provide climate risk insurance to the world's most climate vulnerable and poor (G7, 2015). In 2017, InsuResilience received another boost by forming a Joint Partnership with more countries, NGO's and private insurance companies (InsuResilience, 2017) and in 2019 InsuResilience declared that it would be, among a host of other deliverables, supporting adaptation "through climate and disaster risk finance and insurance solutions" (InsuResilience, 2019:1).

One of the NGOs that was formed was the Munich Climate Insurance Initiative [MCII]. The MCII, initiated by Munich Re, is an example of multiple stakeholders, including market-based practitioners and scholars, supporting an international initiative to provide insurance as an economic tool to deal with climate change (MCII, 2005). MCII clearly grounds insurance in the international scene when their November 2016 report states, "The relevance of insurance as a tool within comprehensive climate risk management has been recognized by policymakers around the world and is now anchored in major international policy agendas" (Schäfer et al., 2016; p8). In the case of climate adaptation, MCII argues that insurance can help protect the most vulnerable from climate change impacts, including improving anticipatory, absorptive and adaptive capacities (Schäfer et al., 2016).

Around the same time, several insurance initiatives were launched within agriculture. Malawi began pilot projects to insure groundnut from drought in 2005 and 2006 (Suarez & Linnerooth-Bayer, 2010; Meze-Hausken et al., 2009); Ethiopia experimented with index insurance through

the R4 Rural Resilience Initiative (Peterson, 2012; Adegoke et al., 2017). The Agriculture and Climate Risk Enterprise [ACRE] in Kenya, now spreading through sub-Saharan Africa, began in 2009 under a different name and provides insurance products to agricultural communities (Adegoke et al., 2017). Much later, in 2011, the Assurance Récolte Sahel insurance project, covering Mali, Burkina Faso, Senegal and Benin with a pilot in Ivory Coast in 2017 (Adegoke et al., 2017), began selling insurance. These programs, and multiple others not listed here, received many accolades. The projects provided needed cash and quick pay-outs, contributed to resilience and supported food security (Adegoke et al., 2017; Meze-Hausken et al., 2009; Suarez & Linnerooth-Bayer, 2010). In fact, this insurance was considered so successful that calls for insurance in the adaptation context have continued (Schäfer et al., 2016; InsuResilience, 2017; InsuResilience, 2019).

However, another group of researchers and authors did not and does not share this enthusiasm. In fact, these authors claim that the results are not so clear, and that insurance cannot provide this transfer of finances from wealthy to poor. St. Lucia had a program called Livelihood Protection Program developed and sponsored by Climate Risk Adaptation and Insurance in the Caribbean [CRAIC] and MCII and subsidized by the German government (Knudson, 2018). The program was, among other things, supposed to increase climate adaptation. However, the basis risk (uncovered loss due to differences in proxy and actual loss or inaccuracy of proxy to specific damage) had enormous variations, the profits for the underwriter despite the subsidy and high premium were minimal if any, and insurance targeted at a country serves to return the situation back to the status quo, not to adapt (Knudson, 2018). Furthermore, research on the same insurance products that were lauded also demonstrated that individual policy holders became more vulnerable to financial market volatility, lost or reduced local risk management strategies and incentives became decoupled from the actual climate (Adegoke et al., 2017; Panda et al., 2013; Peterson, 2012; Meze-Hausken et al., 2009; Müller et al., 2017; Taylor, 2016). The issues do not end with these research findings. Insurance with an “actuarially sound market-based price” can never provide a net redistribution of wealth (Johnson, 2013b:2676), instead it

transforms the policy holder into a financial risk- bearer instead of a rights-bearer (Johnson, 2013b), and insurance in agriculture can even drive maladaptive outcomes (Müller et al., 2017).

These insurance programs and products are based on one of two types of insurance: parametric, also known as index insurance, and traditional indemnity insurance. Parametric insurance is based on a trigger. In the case of climate change this is normally a physical trigger such as wind speed, aridity of soil, or amount of rain (Hochrainer et al., 2009). If the agreed upon trigger is reached or passed, then the insurance will pay out whatever sum agreed on in the contract. Indemnity insurance, in contrast, is based on actual physical damages, not the damage-causing physical occurrence. A policy holder receives a pay-out if the damage-causing occurrence is covered in the contract, but the pay-out is contingent on the actual, measured damage. Today, most insurance for individual policy holders is indemnity, however, in the climate change space parametric is becoming the norm.

Parametric [index] insurance provides some advantages. Payouts can occur faster, an advantage for the policy holder (Muneepeerakul et al., 2017; Suarez & Linnerooth-Bayer, 2010) and the policy holder need not prove ownership of any assets which opens up insurance to the poor (Johnson, 2013b). Moral hazard is supposed to be reduced (Taylor, 2016; Johnson, 2013b) and adverse selection is irrelevant which is an advantage for the insurance provider. The insurance company does not have to do any inspection and pay-outs are uniform across policy holders in specified geographic areas (Suarez & Linnerooth-Bayer, 2010; Taylor, 2016), an advantage for the insurance provider because it reduces the cost of the insurance product. In addition, index insurance can be provided to an entire country as a type of “proxy” instead of to each individual policy holder (Grove, 2012). This enables quick access to liquid cash for the participating country (Grove, 2012). However, parametric insurance is not connected to the actual damage or loss which causes what is called basis risk (Muneepeerakul et al., 2017;) nor is there a guarantee that pay-outs to countries will go to those suffering the loss in the country (Grove, 2012).

Basis risk has two aspects. Production basis risk which is when the index trigger does not correspond to the correct potential damages and geographical basis risk when the meteorological stations measurements do not match the weather conditions of the policy holders, due to distance or complex weather patterns (Muneepeerakul et al., 2017). Basis risk is an issue for several reasons. A pay-out may be much lower (or non-existent) or higher than the actual damages; the first results in a frustrated and vulnerable policy holder and the second results in false-positive pay-outs for insurers, although this “gain” for the policy holder without damages is argued to be a positive reinforcement for good practices (Muneepeerakul et al., 2017; Pierro & Aid, 2010; Taylor, 2016). Basis risk also raises issues of program distrust and of equity between policy holders when adjacent properties with dramatically different damages receive the same pay-out or when distant properties experiencing different storm or weather challenges also receive the same pay-out (Knudson, 2016). Furthermore, Muneepeerakul et al. (2017) discovered that even with local meteorological stations, well indexed triggers and correct match between trigger and damages, basis risk still remained an issue due to the complexity of weather patterns, especially in the form of intensity and frequency when the trigger is rainfall (Muneepeerakul et al., 2017).

The advantages and challenges of index insurance are not limited to individuals with an index insurance policy. States and even multiple countries can buy insurance. The first region-wide insurance pool was in the Caribbean, the Caribbean Catastrophe Risk Insurance Facility [CCRIF]. Today there are two others, the Pacific Catastrophe Risk Assessment and Financing Initiative and the Africa Risk Capacity Insurance Company Limited. Based on research of CCRIF pay-outs, history and procedures, this type of insurance is supposed to guarantee the State's survival and provision of goods and services through quick access to cash after an event and, theoretically, to provide finance for climate adaptation (Grove, 2012; Lobo-Guerrero, 2010).

Simultaneously, climate weather derivatives entered the international financial market scene. These are often called disaster or catastrophic insurance and are based on parametric insurance

but financially function as weather derivatives (Johnson, 2013a). This form of insurance (or derivative depending on who is the speaker and audience) earns high rates on the stock market because of its high risk, which also makes it interesting for investors who are willing to take this risk (Johnson, 2015; Taylor, 2020). Mexico had the first parametric insurance financialized on the international market against earthquakes in 2006 with magnitude as the trigger (Lobo-Guerrero, 2010). The risks are financialized through various instruments, for example the most well-known catastrophic bonds – called cat bonds, which are then sold on the international financial market, essentially forming a blend between insurance and capital markets (Lobo-Guerrero, 2010).

All of these programs and products are, along with several other functions, supposed to be climate change adaptation, drive climate change adaptation or enable climate change adaptation. In this dissertation all these terms are lumped under insurance for adaptation. As mentioned, these programs are often also supposed to have other functions as well such as providing for loss and damage (Warner et al., 2012), enabling States to remain in power (Lobo-Guerrero, 2010; Grove, 2012), and support resilience (G7, 2015; Müller et al., 2017; Schäfer et al., 2016; Knudson, 2016). This dissertation, however, focuses on insurance for adaptation.

Climate Adaptation

Climate change adaptation is a growing global challenge. The World Economic Forum (2013) called the failure to adapt one of the most challenging global risks and at COP 23, the United Nations Environment Programme [UNEP] distributed its report on the lack of adaptation, The Adaptation Gap (UNEP, 2018).

The IPCC (2014) defines adaptation as “adjustments in natural or human systems in response to actual or expected climactic stimuli or their effects, which moderates harm or exploits beneficial opportunities”. Basically, adaptation is supposed to avoid or lessen the impacts of climate change (Adger et al., 2005). However, adaptation can negatively impact both people and environments (Eriksen et al., 2011) which triggers critical questions about justice: Who should

adapt and who gets to decide? When? How? Where? What locations will have to adapt first (Meerow & Newell, 2016; Eriksen et al., 2011)? Furthermore, some adaptations could be aimed at local conditions while others could be aimed at reshaping whole systems. Likewise, some adaptations could be aimed at specific adaptive capacities pertaining to a single issue while others could be aimed at generic adaptive capacities such as improving financial assets (Eakin et al., 2014; Lemos et al., 2016).

These calls for adaptation are not theoretical discussions. Instead, they are in the context of increasing loss from climate change related events around the globe. Less wealthy countries are attempting to find manners to recover from the extreme events, maintain a certain level of economic development despite climate change, and have access to funds when a catastrophic event does occur (Linnerooth-Bayer and Hochrainer-Stigler, 2015; Schäfer et al., 2016). Wealthy countries are discovering that their wealth does not protect them from fire, hurricanes and sea level rise. One of the responses, as mentioned earlier is to find a manner to finance climate change adaptation through insurance for adaptation.

Insurance and adaptation before climate change

Interestingly, insurance has already been playing a role in adaptation or lack thereof for a long time; long before climate change was on most peoples' radar. In the United States, arguably, insurance as adaptation governance has been operating at least since 1968 when the National Flood Insurance Program [NFIP] was established. After massive flooding in the US in the first half of the 20th century, private insurers left the market due to their inability to assess the risk (Michel-Kerjan, 2010). In 1968, the federal government created the NFIP to decrease federal disaster aid, decrease flood loss, and "discourage uneconomic development in floodplains . . . and encourage less risky use of floodplains" (Thomas and Leichenko, 2011). One of the primary reasons for its existence was to hinder what today may be called maladaptation, and push individuals to buy flood insurance. The US government would pay costs; private insurance companies would offer the insurance product and enforce the rules (Michel-Kerjan, 2010).

The NFIP provides both a note of caution to all insurance programs intended to mitigate loss and damage and provide adaptation as well as a note of hope. The NFIP has pressured and forced millions of homeowners and commercial businesses, through local government, to build better and sturdier foundations, leave space for floodwaters, and maintain retention and flood space, (FEMA, 2017; National Flood Insurance Act of 1968, 2019). All of these do appear to be some type of adaptation to living in floodable areas.

However, after the enactment of the NFIP in 1968, building in risky locations increased (Montz et al., 2017; White et al., 2001), and government disaster spending increased (Montz et al., 2017; White et al., 2001). This raises an even more fundamental question. Is it possible for insurance for adaptation to be effective?

Gaps and juxtapositions for research questions and articles

At the most basic level there must be relationships between the insurance industry and local places that enable insurance to impact climate adaptation. What are they? A complex adaptive systems (CAS) lens is particularly well suited to examining relationships. Therefore, using a CAS lens, this dissertation develops a CAS stock and flow diagram to use and interrogate the odd juxtaposition between those pushing and lauding insurance for climate adaptation and those providing theoretical, empirical and practical evidence cautioning against the total embrace of insurance. This CAS lens provides a manner to 'see' the dichotomy between advocates and skeptics, the contradictions named below and relationships as pieces of the whole system.

However, the international calls for insurance for adaptation and those questioning these calls is not the only odd juxtaposition in insurance for climate adaptation. Insurance is ubiquitous in wealthy countries and for most wealthy in most countries of the world. Simultaneously, insurance is for the most part invisible or incomprehensible to most people and is based on probabilistic calculations which no one truly understands in any intuitive manner. In Hazards & Disasters

research, already since the 1970's (White, 1974) insurance solutions do not necessarily reduce risk, and in some cases have even increased the losses (White et al., 2001; Montz et al., 2017). A recent example of this contradiction is highlighted by FEMA buyouts. Eight of the states with floodplain buy-outs financed by FEMA were eight of the same states with the fastest development in floodplains (Flavelle, 2019). Interestingly, without insurance, this land development could not have happened. Despite these odd juxtapositions, western society and the wealthy have come to rely upon insurance as a manner to protect wealth, enable expenditures on other goods and maintain a specific lifestyle (Arena, 2008; Liedtke, 2007).

Due to this reliance and the relationship between insurer and policy holder, insurance's ability to shape adaptations to hazards, insurance can be seen as a governor of that which it insures. The question, however, becomes, how? How could or does insurance govern those to whom it provides insurance? Is it possible to gain new insights through using a governance lens and what might those insights be? What may the consequence be if insurance is functioning as a governor of climate adaptation?

Recognizing the governance role of insurance allows us to analyze the relationships between the tools that insurance uses and the actions of those with insurance, specifically who is required to do what, when, where and why. With this information separated according to insurance tool, it is possible to determine what a person with insurance is adapting to, the changing climate, the changing social circumstances and/or the changing financial circumstances. Furthermore, it is possible to examine equity and justice consequences of using insurance as adaption through insurance as governance lens and build the foundation for potential new insurance products that drive equitable climate adaptation.

Organization of dissertation

This dissertation is in the three-article format. This introduction contained the background of the relationship between insurance and climate change adaptation governance, the gaps and juxtapositions which this dissertation begins to fill in and a brief outline of each article which follows.

The first article addresses the apparent contradiction in those supporting and pushing insurance for climate adaptation and those questioning the ability of insurance to provide any support for the poor and most climate vulnerable. The article uses a complex adaptive systems lens to examine the relationships between insurance's global rules and network impact on local communities and the inverse, local impact on global insurance and financial networks and markets. The article is framed within the liberal international order where insurance has been playing a major role in pushing climate change discussions and actions. The CAS lens uncovered two different feedback loops, one balancing and one reinforcing. The difference in feedback loops drives what Johnson (2015) has called splintering where some with high value, high risk property will be able to remain in place for a long-time because of 'adaptation' requirements but will eventually be forced to move because they are not reducing exposure with the costs of their 'left' property falling on the government or those left behind (Taylor, 2020). CAS also illuminated the difference in how adaptation is perceived and implemented between the advocates and skeptics of insurance for adaptation. Those who support insurance for adaptation focus on generic adaptive capacities reducing sensitivity and connecting policy holders to the international financial market. The skeptics focus on reducing exposure to specific climate change consequences. Furthermore, the CAS approach sheds light on what is included in the connections between policy holders and insurance. A policy holder only passes a certain percentage of financial risk to the insurance along with payments. The insurance provider does pass along financial compensation in the form of pay-out if certain conditions are met but vulnerability to the international financial market is also passed in the flow to policy holders.

A CAS lens also provides alternative manners to view insurance in the climate adaptation space. The influence that insurance exercises over policy holders can be viewed as governance. In addition, this same influence should probably be researched using the many theories of power that exist within decolonialism, political ecology, sociology and political science. Furthermore, the lack of diversity and modularity within insurance raises issues of a monoculture of risk management and extreme dependency on insurance.

The second article is based on one of the findings from the first article: through its asymmetrical information and power relationship with policy holders, insurance can and does govern the actions of those who it insures. Unfortunately, despite advocates' emphasis on the influence insurance has on policy holders, the ability to govern appears to be unacknowledged within the climate adaptation context. The second article delves into the tools that insurance can and does use to govern.

Despite widespread recognition of climate change, adaptation to the many hazards caused or exacerbated by the changing climate has been slow. Multiple international organizations view insurance as a means to pressure and to procure this lagging and missing adaptation. Insurance does have the ability to shape adaptations to hazards and has been called a regulator and governor of that which it insures. This article investigates how insurance functions as governance; why recognizing insurance as governance matters; and how insurance could be governing climate change adaptation and what the consequences might be. To tackle this last question, the article builds a structural assessment tool to use the growing body of theoretical and empirical literature on insurance as explicit and implicit governance to critically examine the potential implications of insurance governing adaptation. The analysis reveals that relying on insurance as adaptation or to drive adaptation presents four key concerns. Insurance 1) reduces financial risk for some but does not necessarily reduce vulnerability; 2) may cause risk displacement within and outside of risk pools; 3) will structure climate change adaptation to the demands of indemnity and index insurance which could have long-lasting unintended

consequences and could enhance telecoupling issues already in play through globalization; and 4) may unintentionally shift authority over adaptation away from governments to private insurance companies and other non-state actors. Despite these concerns, because insurance can and does govern, if insurance governance tools are used to specifically focus on adaptation to the changing climate, insurance still may be one of the better means to promote climate change adaptation.

The third article focuses on the implications of insurance governing climate adaptation in explicit insurance adaptation agricultural cases. The IPCC, along with various other international organizations, lists insurance as a potential tool for adapting to current and impending climate change. In addition, a growing body of literature demonstrates that insurance for a variety of risks often functions as a form of governance capable of shaping multiple actors' decisions, both explicitly and implicitly. Despite recognition of the potential for insurance to act as a form of governance, few analyses have focused on the implications of this for adaptation and climate justice. This paper demonstrates that by viewing insurance as a form of governance insights can be gained into what insurance for adaptation might mean from a justice perspective in the climate adaptation context. Based on the insurance as governance literature, this paper uses a structural assessment to critically analyze agricultural climate adaptation insurance from a justice perspective. Using this approach agricultural climate adaptation insurance raises some potential justice concerns and does not appear to fulfill international calls for insurance to be or to drive adaptation to the changing climate.

Chapter 5 delves into alternative approaches which would complement this research, enumerates potential solutions that use current forms of insurance and discusses two challenges which any solution must grapple with. Essentially this chapter forms a foundation for future application of insurance in the climate adaptation context as well as future research to enable this application.

The conclusion further discusses and reviews the most prominent contributions of the dissertation. In particular, it sets out the theoretical findings in a broader context. It then ties the policy contributions to the theoretical findings and, when applicable, also ties the policy contributions to a broader context.

While supporting climate adaptation for those who have not caused climate change but are disproportionately suffering the consequences should be lauded, it is important to remember that top-down programs that do not explicitly include justice concerns often go awry (Marino & Ribot, 2012). We know that climate adaptation does not have easily identifiable solutions and, depending how the solutions are chosen and implemented, strategies could actually increase inequities (Adger et al., 2005; Eriksen et al., 2011; Smit & Wandel, 2006). This only increases the importance of scrutinizing adaptation policies which combine public and private governance, cross temporal and spatial scales and purport to solve local challenges with global solutions. My dissertation contributes to the interrogation of these spaces within the insurance for climate adaptation context.

CHAPTER 2

MORE THAN THE SUM OF ITS VISIBLE PARTS: (RE)INSURANCE, GLOBAL CHANGE AND CLIMATE ADAPTATION

Abstract

The (re)insurance industry has pledged billions of dollars through InsuResilience and through partnerships with international governmental organizations and NGO's to expand insurance coverage for the world's poor and climate vulnerable. One of the goals is to drive climate adaptation through this insurance finance mechanism. The (re)insurance industry is not a new actor in the liberal international order although the discussion of its impact has often remained invisible. One way to gain insight into this opaque process is through complex adaptive systems [CAS]. Analyzing (re)insurance using a CAS lens sheds light on the relationships between actors that otherwise go unnoticed, especially insurance's global impact on local communities and, the inverse, local impact on global insurance and financial markets. Focusing on these relationships reveals the various impacts of insurance, provides theoretical understanding for contradictions in local political choices and for connections between global financial changes, local disasters and re-development, and, opens up alternative manners to view insurance in the current changing global order.

2.1 Introduction

A 2019 New York Times article states in the United States “flood-prone areas have seen the highest rates of home construction since 2010” (Flavelle, 2019) yet more and more people are looking to buyouts after floods (Rosalsky, 2020). In the same period, studies have found climate adaptation lags dramatically behind what is necessary both in the United States and globally (Moser et al., 2017; UNEP, 2018). Multiple academics, (re)insurance companies and NGO's have named insurance as a remedy to this adaptation gap, both for those already insured and for the global poor and most climate vulnerable (Dlugolecki, 2008; Hecht, 2007; Schäfer et al., 2016; InsuResilience, 2017). Recently in a communique to the United Nations Climate Action Summit,

InsuResilience and those working with them announced their plan to activate “US\$5 billion of risk capital offered by the insurance industry to provide the necessary risk capacity”(InsuResilience, 2019), for, among multiple goals, climate adaptation (InsuResilience, 2019).

The calls for reinsurance and/or insurance to fulfill a function within the climate adaptation space take several forms. These forms include insurance as adaptation, insurance to drive and even force adaptation, insurance to enable adaptation and insurance for resilience which can include all of the already listed forms. This article combines all these forms under insurance for adaptation because the focus of this article is on (re)insurance and its relationship to climate adaptation, not on the particular discourse of a program or call.

Despite these multiple calls and programs covering insurance for adaptation, questions remain. Many articles laud insurance for adaptation. Their reasons range from improved financial circumstances (Suarez & Linnerooth-Bayer, 2010) and connections to the international financial market (Adegoke et al., 2017; Meze-Hausken et al. 2009; Swain 2014) to quick access to more seeds (Adegoke et al., 2017; Hochrainer et al., 2009) and access to fertilizer (Adegoke et al., 2017; Panda et al., 2013). Some also discuss how insurance could guide crop choices and building choices (Adegoke et al., 2017; Ward et al., 2008), force livelihood choices (Suarez & Linnerooth-Bayer, 2010) and even force relocation (Suarez & Linnerooth-Bayer, 2010).

In contrast, a growing number of articles question this turn to insurance. Some argue that sustainable, long-term use of the land has been trumped by adjustment to the international financial system (Knudson, 2018; Müller et al., 2017; Taylor, 2016). Some argue that insurance is a form of security for States and larger actors on the international financial market without per se driving any kind of climate adaptation (Grove, 2012; Lobo-Guerrero, 2010) and some argue that this climate adaptation insurance transfers climate risk to individuals (Johnson, 2013b; Müller et al., 2017).

The apparent dichotomy raises several questions. Are there relationships within the (re)insurance industry that enable (re)insurance to impact climate adaptation? What structures do these relationships create? If insurance is impacting climate adaptation, is local adaptation also impacting (re)insurance? Are there structures or relationships that can clarify the apparent dichotomy in the literature, the contradictory 'adaptation' policies at the local level and illuminate insurance's relationships and capacity for climate adaptation?

A complex adaptive systems approach provides a manner to 'see' the dichotomy, contradictions and relationships as part of the whole system and reveal the pieces which are needed to understand interdependencies, their consequences and the surprise and nonlinearities that they bring (Young, 2017). Therefore, this article turns to a complex adaptive systems lens which is the study of interdependencies, interconnections, the role of internal structure on these relationships and the connections between structural goals and purpose. Viewing the (re)insurance industry as an actor in a complex adaptive system enables a deeper understanding of apparent contradictions in local adaptation policies, of connections between global financial changes, local disasters and re-development, and, opens up alternative manners to view insurance and its role in the current changing global order. In addition, using this CAS lens, fulfills both Young (2017) and Galaz (Galaz, 2014; Galaz et al., 2018) calls for the necessity to recognize complexity within political science and to use this recognition to improve global governance in these changing global circumstances.

First, the article will discuss the methods and complex adaptive system lens. Next the article will review adaptation and insurance literature and demonstrate that insurance for adaptation can be viewed as a CAS. Then in the results section this article provides a simplified diagram of the (re)insurance for adaptation system and using this CAS lens explores the apparent dichotomy between advocates and skeptics of insurance for adaptation. In the discussion this exploration reveals the most basic structure by which global (re)insurance impacts local adaptation and how

local adaptations impact global (re)insurance. Finally, this exploration also demonstrates alternative manners to view insurance and its role in the current changing global order.

2.2 Methods and Complex Adaptive System lens

This is a qualitative, exploratory article which addresses insurance for adaptation in a novel manner, through a complex adaptive system [CAS] lens. This research is exploratory to raise and then answer questions about what otherwise appears settled regarding insurance in the liberal order, about assumptions in insurance for adaptation and about the root causes of the lack of adaptation that fails to occur again and again across the globe despite our best efforts to alter, drive or otherwise enable climate adaptation (Meadows, 2008).

The article reviews the literature of complex adaptive systems in this section to describe what a CAS lens entails. The article then follows with a review of climate adaptation and its connection to (re)insurance, and what (re)insurance is, focusing on the industry in the international liberal order.

Next, following in the footsteps of Young and Galaz (Galaz, 2014; Galaz et al., 2018; Young, 2017), the article explains how insurance for adaptation is a CAS and provides a simplified stock and flow diagram of insurance for adaptation. The stock and flow diagram is simplified to maintain focus on basic relationships and their consequences and to 'see' the connections between the CAS components. Using these CAS components, the study compares advocates and skeptics of insurance as adaptation approaches and adds CAS insights tied to those components. The study uses two compiled case studies to demonstrate the results.

Broadly, complex adaptive systems are systems with interdependent, interconnected, diverse elements that can exchange information and change over time (Mitchell, 2009; Meadows, 2008; Miller & Page, 2009). The sum of the individual elements does not equal the whole; the connections between the pieces must be included (Miller & Page, 2009). This whole, how these

relationships are structured in combination with the goal, produces its own emergent pattern over time (Meadows, 2008).

A system can be imagined as a set of stocks and flows (Meadows, 2008) which illustrates the interconnected and interdependent nature of CAS. The relationships themselves provide information and understanding about what impacts what through these connections and how these relationships are structured (Mitchell, 2009). Furthermore, these connections are places of transfer, forming interdependencies (Mitchell, 2009). One element may exert extensive influence over another or multiple other elements (Mitchell, 2009) while some elements iteratively influence one another (Mitchell, 2009; Young, 2017). These interconnections and interdependencies can be physical, organizational or ideational and can be cross-scale (Mitchell, 2009; Meadows, 2008).

Elements are a set of diverse parts that are in relationship through these interconnections and interdependencies (Meadows, 2008). These elements may be physical things such as humans, built infrastructure or organizations but they can also be intangible such as concepts of risk and urgency surrounding climate change discussions. The key aspect is how these elements may affect one another, and how these effects interact and impact the whole (Meadows, 2008).

Complex adaptive systems have a goal. Interventions to alter a system that do not recognize the actual goal of the system will only be partially successful, fail or result in undesirable consequences (Meadows, 2008). Stated goals are easy to recognize but we know from Ostrom (2009) that stated goals are not always the primary goals nor the goals that 'guide' the structure of the relationships (Meadows, 2008). One manner to discern the goals is through feedback loops.

Feedback loops are information carrying interconnections and interdependencies. Feedback loops come in two basic forms: balancing and reinforcing. Balancing feedback loops attempt to keep the system within a specific range and reinforcing feedback loops move the system in one

direction (Meadows, 2008). Feedback loops provide key information on the structure of the system and alter linear causality providing for surprise and increase the difficulty of prediction (Young, 2017; Meadows, 2008; Mitchell, 2009).

This article will use stocks and flows to visualize the nonlinear state of CAS, view feedback loops, consider what is being transferred in the relationship, and emphasize the location, physical or figurative, where material or information accumulates or is depleted. With these interconnections and interdependencies clearly signaled, it is possible to recognize the global impact locally and local impact globally, recognize the different adaptation goals and thus structures discussed by those who support and critique insurance for adaptation and recognize both theoretical and practical alternative approaches to insurance for adaptation.

2.3 Literature review

To understand insurance for adaptation through a CAS lens, we must begin with what adaptation and insurance mean. This literature review will first discuss what adaptation is in the international climate change context and then discuss the basic history, principles and concepts in the insurance industry.

Adaptation

The Intergovernmental Panel on Climate Change defines adaptation as the “adjustment in natural or human systems in response to actual or expected climactic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2014). The adaptations can be at multiple scales ranging from local or community-based to global, often with differing objectives across scales (Adger et al., 2005). However, even adaptation that appears successful “can have negative unintended effects both on people and on the environment” (Eriksen et al., 2011:8).

Key is that adaptation is in response to the changing climate (IPCC glossary). Thus, reducing vulnerability to the changing climate – reducing sensitivity, reducing exposure or increasing

adaptive capacity to react to the changing climate would all potentially fulfill climate adaptation (Adger, 2006; IPCC, 2014; Smit & Wandel, 2006). Furthermore, adaptation scholars divide adaptive capacity into two approaches. Specific adaptive capacity is the ability to adapt to a specific climate threat while generic adaptive capacity refers to general well-being and development. Both are necessary for climate adaptation to be effective (Eakin et al., 2014).

One popular instrument to achieve this climate adaptation is insurance. The basic idea is that insurance can help protect the most vulnerable from climate change impacts, including improving anticipatory, absorptive and adaptive capacities (Schäfer et al., 2016).

(Re)insurance

Background – History and brief descriptions

Munich Climate Insurance Initiative clearly grounds insurance in the international scene when their November 2016 report states, “The relevance of insurance as a tool within comprehensive climate risk management has been recognized by policymakers around the world and is now anchored in major international policy agendas” (Schäfer et al., 2016:8).

In climate adaptation there are two forms: indemnity and parametric. Indemnity insurance is a form of risk management through a transfer of finances. It is to protect, not the (physical) asset to which an event may occur, but the financial investment in that specific asset. Since the 1770’s it has been based on the law of large numbers and actuarial science (Lobo-Guerrero, 2010). This means the insurance pool must be large enough to: statistically calculate any single event; guarantee lack of correlation between policy holders and between events; and, guarantee the ability to cover any given loss at a time or there must be enough liquid assets available to do so. The value of the assets covered, and the potential ‘cost’ of the event must be predictable and measurable (Rejda & McNamara, 2013). Moral hazard, the undertaking of risks due to the presence of insurance, must be suppressed (to avoid correlations and false pay-outs) and

adverse selection, those who have the most risk seek insurance, must be minimized (Rejda & McNamara, 2013).

Parametric [index] insurance, also requires a large enough pool, large enough spread, and measurability and predictability. However, parametric insurance is not based on an event occurring to one specific investment in an asset or asset type. Instead, parametric [index] insurance is based on the event itself. Pay-outs are based on some specific “trigger-event” such as wind speed or soil aridity (Hochrainer et al., 2009). If this trigger is reached or surpassed, depending on the contract, the provider will pay a specific agreed upon sum to the policy holder, regardless of the actual damages the policy holder suffers. Parametric insurance is not limited by the reach of actuarial science. Instead, parametric insurance is based on catastrophic modeling which enables parametric insurance to go beyond historical data for prediction (Johnson, 2015).

The ability of parametric insurance to be decoupled from the actual asset, alters index insurance into what many in the banking industry call a derivative (Briys & De Varenne, 2001). Essentially, these are financial instruments to ‘make money’ off risk while providing the policy holder, reinsurance company or country with some financial compensation when a disaster occurs (Johnson, 2015). This same decoupling is the root of basis risk, which index insurance at all scales struggles with (Muneepeerakul et al., 2017). Essentially, what the policy holder does to the asset no longer is related or relevant for the insurance provider. This removes traditional moral hazard and adverse selection concerns. For climate adaptation this means what the policy holder does or does not do to adapt is irrelevant for the insurance provider.

Actors, scales and relationships

There are multiple actors involved in these insurance transactions. There is the policy holder: the individual, organization, State or other actor who buys insurance from the primary insurer. Primary insurance providers are the organizations which provide the actual insurance and payouts to policy holders. To remain solvent, even in the face of a disaster or multiple

simultaneous events, primary insurance providers require their own insurance: reinsurance. Reinsurance is insurance for primary insurance providers, although reinsurance also provides insurance for other entities directly and indirectly. The principle in reinsurance is the same as insurance, only spread is even more important.

Both primary insurers and reinsurance are predominantly private. Private insurance, however, is not the only insurance available. States provide insurance (i.e. National Flood Insurance Program in the United States) or function as an insurance (i.e. the Dutch government for flooding). The only difference is that private insurance must turn a profit and public forms must (should) break even.

Furthermore, primary insurers collaborate with reinsurers and both collaborate with governments, non-profit organizations and international governmental organizations. Despite the variation in actors, all these insurance providers still must abide by the actuarial necessities of indemnity insurance or, in the case of index, by the dictates of catastrophe modeling (Rejda & McNamara, 2013; Hochrainer et al., 2009). In addition, both must abide by the dictates of the international financial market.

Since at least the 1880's (re)insurance has been globally networked, meaning primary insurers relied on reinsurers to cover large or concurrent events and these reinsurers are global, connected through primary insurers and directly connected to one another and connected to the international financial market (Rohland, 2011). The reinsurers had to have enormous spread both globally and type of coverage (fire, flood etc.) to be able to absorb even a single event which would prompt a pay-out to its clients (Rohland, 2012). Those that did not, went bankrupt or rectified their lack of spread (Rohland, 2012). In addition, reinsurance companies have cooperated and collaborated since their inception (Rohland, 2011).

Today these interconnections are even further enhanced through ownership, investments and derivatives. One large investment company may own multiple reinsurance and insurance companies. Primary insurance companies invest directly on the international financial market (Cook & Dowlatabadi, 2011), some even earning more on their investments than on premiums (Cook & Dowlatabadi, 2011). More recently, the (re)insurance companies also began selling insurance-linked securities [ILS] which include weather derivatives and catastrophe bonds as a manner to create a profit off of the growing climate risk and provide for more liquidity which is necessary with growing climate risk and growing concentration of high risk high value properties (Johnson, 2013a). These ILS products are also bundled and created by specialty insurance companies which are sometimes even hyper-local, especially in Florida which sells more than 50% of global ILS products (Taylor, 2020).

Policy holders are even more varied actors distributed across all spatial scales, ranging from a sharecropper to a wealthy coastal villa owner to a small town to businesses of all sizes, to large cities around the world, to States and even groups of States. However, all these policy holders do have a few experiences in common. Insurance contracts are normally renewed on a yearly basis (Johnson, 2015). At each renewal (re)insurance can refuse coverage or raise the premium. For indemnity insurance, policy holders must provide periodic information updates on the asset and many must comply with a company's requirements (i.e. wheel lock for car insurance in some locations) (Ben-Shahar & Logue, 2012). Many policy holders must provide information up front to avoid adverse selection in indemnity insurance and to enable loans or seed replacement in index insurance (Adegoke et al., 2017). With a highly limited set of exceptions, all policy holders must also provide some form of financial compensation usually in the form of a premium (Rejda & McNamara, 2013). Furthermore, all policy holders are directly or indirectly linked, via their own insurance policy and their insurer's reinsurance and investments, to the international financial market.

2.4 Insurance for adaptation through a CAS lens

As described above, the insurance for adaptation system is composed of a diverse set of actors. These actors are interconnected through financial investments and stockholders, governmental regulations, insurance regulations and practice, the international financial market, and climate change. More specifically, policy holders are directly connected to primary insurers and therefore to the rest of the system. Primary insurers are directly connected to policy holders, reinsurance and often the international financial market. Reinsurers are directly connected to primary insurers and large clients such as States, the international financial market, ILS brokers and ILS products.

Retail insurers and insurance brokers also buy insurance from primary insurance companies and wholesale brokers and then resell to individual policy holders. To maintain the article's focus on global impacts on the local and local on the global, these actors are lumped under primary insurers, although they do not all have direct connections with policy holders.

These same actors are also interdependent. Policy holders are dependent on their insurance provider to renew their contract (or not), provide contractual pay-outs and enforce insurance rules and policy. Primary insurance providers, whether public, private or a partnership, are reliant on their policy holders to pay their premiums, the international financial market to provide liquidity, reinsurance to provide liquidity and spread, governments to enforce contracts and, if relevant, for funders to continue providing funds. Reinsurance providers are dependent upon primary insurance providers to pay their premiums, direct policy to pay their premiums, financial investments and the international financial market. Each of the actors exchange information through relationships which have a specific structure based on the (re)insurance industry.

The structure is so interconnected and interdependent that there is little, if any, modularity. Although there are diverse actors and elements, the only form of risk management that is addressed, used or otherwise involved is insurance itself, insurance induced risk reduction or insurance risk transfer.

However, there are various goals within this system. The policy holders wish to protect their financial investment, procure security for their particular form of existence and/or maintain the ability to replace what was lost. Private for-profit (re)insurance providers wish to remain in business and make a profit. Public insurance providers wish to remain financially viable and provide some social function. However, all of these goals are structured primarily accordingly to actuarial sciences and more recently according to catastrophic modeling.

Financial risk and financial payments flow from one actor to another. Physical risk remains with the policy holder. Financial risk flows but also remains in certain locations forming stocks. There are feedback loops which connect the stocks and the flows with one another. These feedback loops, stocks and flows are diagramed in the results section.

2.5 Summary demonstration studies

There are two case studies. One is Florida, United States and the other is an aggregate of explicit agricultural insurance adaptation programs. Both cases involve the private (re)insurance industry. The case in Florida also involves the National Flood Insurance Program and the Citizen Property Insurance Corporation. In addition to private (re)insurance, the agricultural cases include a range of other actors from other private businesses such as seed and fertilizer businesses to the World Bank and State subsidies (Adegoke et al., 2017). These other actors will be specifically referenced when they are active participants in the pieces discussed.

Florida

Florida, USA is a high-risk location, particularly due to hurricanes which cause wind and flood damage to property. Florida also has a high density of insured properties, both private and commercial. The properties are insured through both private and public primary insurance providers using indemnity insurance. Wind insurance is purely private. Flood insurance is both. The National Flood Insurance Program [NFIP] supplies extensive flood insurance to those with

federally backed mortgages and qualifying properties. The insurance itself is sold through private insurance providers. Citizen Property Insurance Corporation is a provider of last resort for residential property but is not further discussed in this article. Those who do not qualify or can pay for special conditions buy flood insurance on the private market.

All private insurance providers should and normally do have reinsurance. Since Hurricane Andrew in 1992, most private primary insurance providers also have direct investments on the international financial market (Cook & Dowlatabadi, 2011). More recently, Florida has become the geographical concentration of specialist ILS insurance firms. These are a “type” of primary insurance provider that only insure high risk, high value residential property through insurance-linked securities [ILS] (Taylor, 2020). In fact, over half of the world’s entire ILS capital is invested in Florida (Taylor, 2020).

There is a desire for an expanded pool of global policy holders so Florida can maintain its current built environment and development (Medders, 2017). One skeptic of insurance in the adaptation context states that private wind and fire insurance in Florida is underwritten by the requirement of flood insurance which is primarily through NFIP and not at actuarial prices (Taylor, 2020).

Furthermore, Florida is continuing to develop its high-risk property (Goodhue & Harris, 2020; Harris, 2018).

Agricultural cases

Most agricultural insurance programs that are for or include climate adaptation are located in the Global South, in developing countries. The programs this article draws from are explicitly for climate adaptation or supposed to target climate adaptation. They are located in Ethiopia and the Horn of Africa, West Africa, ACRE in Kenya and now spreading to Sub-Saharan Africa and St. Lucia. These locations, for the most part, do not have a high density of insurance and in some there is no insurance available for agricultural activities outside of these programs. The insurance, from the compiled programs, is all parametric insurance.

This article does not refer to any indemnity insurance programs that may be present in these locations. In addition, these cases only deal with direct insurance for individual policy holders. This means that agricultural insurance programs purchased and administered by the State where farmers and sharecroppers may not even know they have insurance and are not actual, conscious policy holders are excluded.

These programs have been created and developed by reinsurance, the World Bank or other international donor/participant and/or the State with the intention of building climate adaptation for low income farmers or sharecroppers who are considered climate vulnerable, or others who are climate vulnerable but without insurance such as in St. Lucia. The programs were originally developed at the international level with the index trigger and the event that it covers set by the program, not participating policy holders.

2. 6 Results: what can 'see' when use a CAS lens

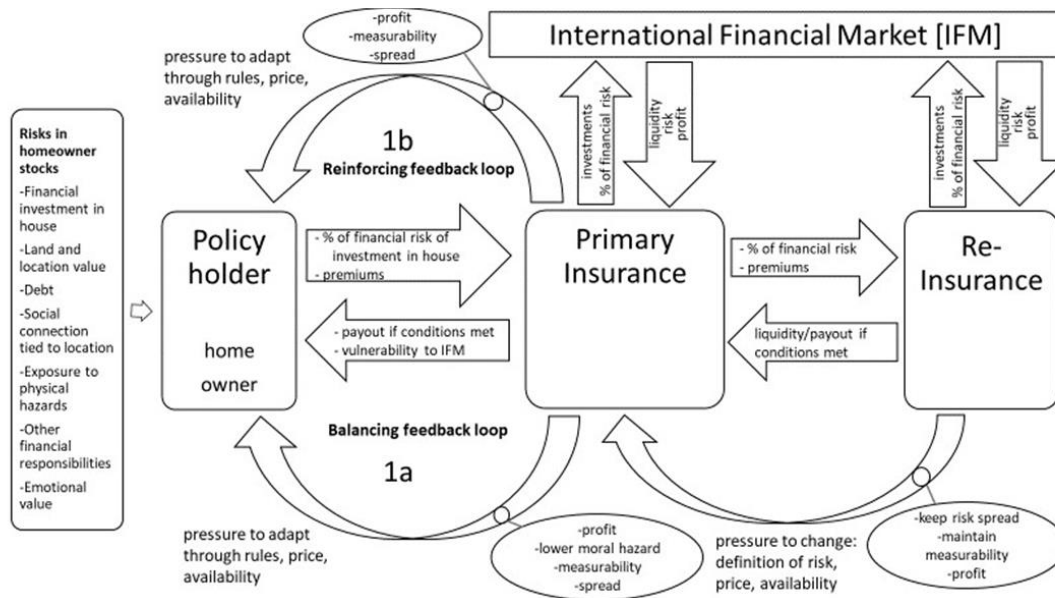


Diagram 1 Simplified stock and flow diagram: the policy holder stock represents all policy holders with the example of a residential homeowner in Florida. This example demonstrates what composes the policy holder risk stock and what is flowing out. The primary insurance stock represents all primary insurance providers. The reinsurance stock all reinsurance providers.

The stock and flow diagram is simplified to only include the basic relationships that play a primary role in climate adaptation. The diagram uses a homeowner in Florida who has private wind insurance and public-private partnership flood insurance to demonstrate what lands in the flow of risk and what does not. Most private property risk and most smaller commercial risk flows will be similar. Larger policy holders such as States and large commercial businesses may not retain as much non-financial risk as private property owners, small businesses and small-scale farmers. Stock in this CAS diagram refers to an accumulation or build-up of risk. Risk accumulates in the policy holder, the primary insurer, reinsurance and the international financial market. Each of these locations of accumulation are stocks where risk can remain or flow into/out of. Risk, finances and vulnerability flow between the stocks and the feedback loops provide information about the relationships between the stocks.

This research used the arguments of insurance for climate adaptation advocates and skeptics to flesh out the stock and flow diagram. What is in the flows largely rests on the different views of advocates and skeptics in what is important within climate adaptation. Advocates view the top-down pressure as exactly what is necessary to drive adaptation where it is not occurring or even to be adaptation because insurance increases generic adaptive capacity through availability of and access to cash and the global financial market (Adegoke et al., 2017; Meze-Hausken et al., 2009; Swain, 2014; Suarez & Linnerooth-Bayer, 2010). Furthermore, insurance reduces sensitivity to the surrounding environment so farmers can plant cash crops (Hochrainer et al., 2009; Osgood et al., 2008) and homeowners can continue living in hurricane heavy locations (Taylor, 2020; Ward et al., 2008).

The advocates focus their attention on the financial risk that is in the flow to the primary insurance provider (Hochrainer et al., 2009) while the skeptics focus their attention on the risks that remain with the policy holder (Knudson, 2018; Taylor, 2016). Furthermore, the advocates do not attend to any transfers back to the policy holder other than pay-outs. Skeptics do. They draw attention

to the volatility of the international financial market which can (and is) transferred through the flow back to the policy holder (Johnson, 2013b).

The flow back to the policy holder is not the only flow that advocates do not attend to. There is another flow from policy holders to (re)insurance: vulnerability. Financial sensitivity is reduced for the policy holder but also for other actors. (Re)insurance receives premiums (which are higher the higher the risk and value) which it then directly or indirectly invests. This reduces their vulnerability to liquidity challenges; however, it also increases reinsurance's exposure to high risk locations in the case of Florida. In addition, the concentration in Florida of ILS, which is then passed on to the international financial market, also increases the vulnerability of the entire financial market to climate shocks located in Florida.

The dominant goals will structure the system (Meadows, 2008). The primary goal of the international financial market is accumulating/making a profit. The primary goal of reinsurance is making a profit. The primary goal of most private insurance providers is making a profit. There are some public insurance providers and private co-op insurance providers, these do not need to make a profit, but should break even and use the same mechanisms as the for-profit organizations. The feedback loop which advocates cite for the effectiveness of insurance for adaptation is based on profit.

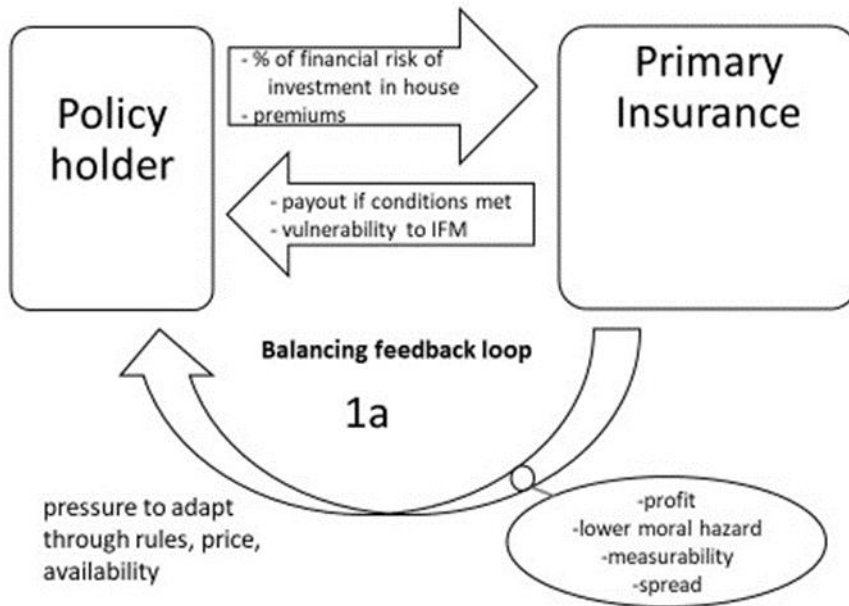


Diagram 2: Simplified stock and flow close-up of feedback loop 1a.

Interestingly, both advocates and skeptics appear to be focusing on the same feedback loop, diagram 1a. This feedback loop consists of finances and risk flowing to primary insurers who then use rules price and availability to maintain a profit, protect their insurance pool and, as a consequence, pressure policy holders to adapt. This is a balancing feedback loop. Primary insurers pressure policy holders to act in ways that minimize risk, therefore also keeping primary insurers from the necessity of increasing their liquidity or spread. In the literature the focus is on reducing sensitivity to risk, building a seawall, installing specific types of shingles, or increasing generic adaptive capacity, such as planting a cash crop or increasing yield through fertilizer (Adegoke et al., 2017; Cooper & Pilkey, 2012; Osgood et al., 2008; Ward et al., 2008). Pay-outs, if a certain agreed upon event occurs, flow in the other direction, along with above mentioned vulnerabilities.

Advocates who discuss indemnity insurance in Florida focus on rules such as roofing requirements (Ward et al., 2008). These requirements protect the profit of the primary insurer, or reinsurance if it is reinsurance placing this requirement, lower the moral hazard of policy holders

and enable a better actuarial understanding of measurability and spread within the risk pool. Simultaneously, roofing requirements in Florida also force the policy holder to lower their sensitivity to high winds in a hurricane. Indirectly, this also raises the adaptive capacity of the policy holder who now does not need to spend extra finances on roof repair after a hurricane.

Advocates who are discussing agricultural climate adaptation insurance focus on the ability of farmers to buy things such as fertilizer and/or plant cash crops (Adegoke et al., 2017; Hochrainer et al., 2009; Osgood et al., 2008). These program rules enable the farmer to take financial risk but still be able to pay back loans (Adegoke et al., 2017; Hochrainer et al., 2009; Osgood et al., 2008; Peterson, 2012). Basically, the program rules are largely focused on increasing adaptive capacity which, if enough cash is earned, can contribute to reduced climate sensitivity in the form of fertilizer, access to a second set of seeds if the first fails or larger planted surface areas (Adegoke et al. 2017; Hochrainer et al. 2009; Osgood et al. 2008; Peterson 2012).

The assumption appears to be that insurance for adaptation is functioning and will always function as the feedback loop 1a. However, this feedback loop does not always exist, especially not in the agricultural climate insurance cases. Parametric insurance is advanced as the insurance for resilience, with this article focusing on adaptation programs, because parametric insurance is no longer connected to the actual activity or property of the policy holder (Suarez & Linnerooth-Bayer, 2010; Johnson, 2013b). This disconnection is supposed to enable insurance for even those who are subsistence farmers and/or own nothing. This disconnection also enables insurance providers to ignore any moral hazard. Basically, all these advantages point to a break in the diagram 1a feedback loop, which discourages adaptation. Skeptics refer to this break in the feedback loop when they bring up basis risk. The insurance program does not need to take notice of anything that is actually occurring to the policy holder, only the measurement station and the agreed upon threshold.

Furthermore, even when a different feedback loop is created in the form of participation rules from agricultural adaptation insurance programs the adaptation feedback loop that is constructed often relies on sensitivity reduction and/or increasing generic adaptive capacity. This reliance is what has stimulated skeptics to challenge insurance for adaptation. They are concerned about exposure reduction (Knudson, 2018; Panda et al., 2013) and limiting maladaptation (Müller et al., 2017).

Indemnity insurance in Florida also contends with a feedback loop that demonstrates its goal to be profit through sensitivity reduction or increasing adaptive capacity. Private wind and flood insurance have plenty of rules, but these are concentrated on reducing sensitivity through building requirements (Ward et al., 2008; Hecht, 2007) or the traditional economic reason for insurance, increasing generic adaptive capacity. In the NFIP there is a formal connection to exposure (National Flood Insurance Act of 1968, 2019). However, in practice it functions similarly to private insurance in that the primary NFIP rules reduce sensitivity, maintain the ability to remain in risky locations or demand hard infrastructure that often raises the risks for others (new developments) or creates vulnerability to larger events through levees or dams (FEMA, 2017; National Flood Insurance Act of 1968, 2019; White et al., 2001).

When this feedback loop that is the fundamental basis for insurance in the climate change adaptation context is broken, or concentrates on sensitivity reduction and capacity building, the system changes. What originally was a balancing feedback loop where insurance providers worked at reducing moral hazard and adverse selection now becomes something else. The balancing piece, where insurance providers limit risk within their pool through rules is gone for parametric insurance and remains limited in indemnity insurance when the focus is sensitivity reduction and increasing adaptive capacity.

Instead, a reinforcing feedback loop takes its place, diagram, 1b. The reinforcing feedback loop takes one of two states. The reinforcing feedback loop is weak when the program is attempting

to reduce sensitivity and increase generic adaptive capacity and does not include high value, high risk property. When high value, high risk property is insured, however, the reinforcing feedback loop becomes strong.

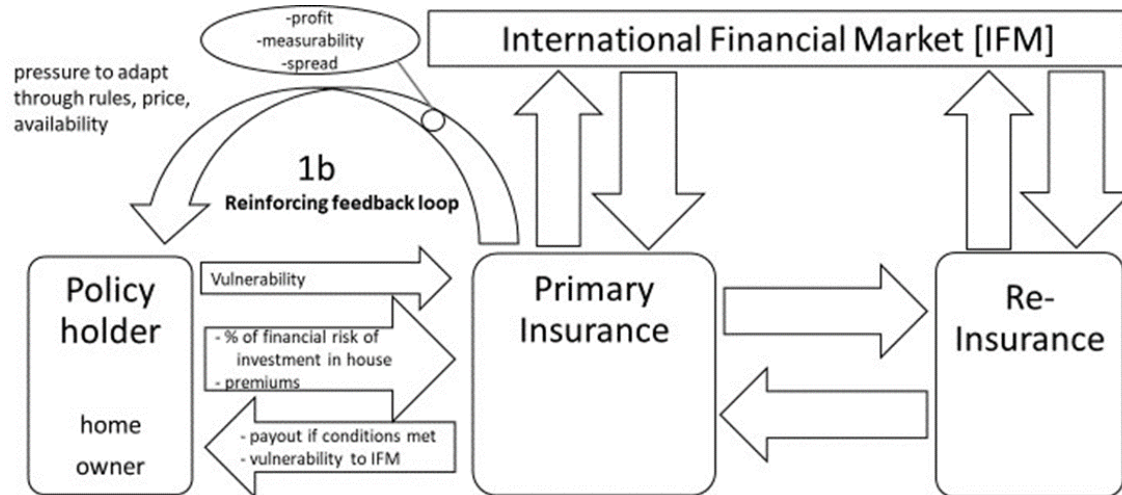


Diagram 3: Simplified stock and flow feedback loop 1b. This is a close-up of the strong reinforcing feedback loop. This close-up includes a flow of financial vulnerability from the policy holder to the primary insurance. This is present because it is a strong reinforcing feedback loop where the policy holder is able to pass this financial vulnerability on to a different networked layer.

The lucrative aspect of the high risk, high value property insurance premiums attracts (re)insurance. Both weak and strong reinforcing feedback loops operate similarly but are most obviously illustrated with ILS firms which form a particularly strong reinforcing feedback loop. An insurance provider specializes in high risk, high value property. This high value, high risk property delivers high premiums which are desirable (Johnson, 2015; Rohland, 2012). Because it is lucrative as far as premiums (re)insurance will stay in the market but instead of leaving the risk in their stock, they pass the risk on to the international financial market through ILS products (Johnson, 2015; Taylor, 2020). In the feedback loop the policy holders are required to reduce sensitivity (Cooper & Pilkey, 2012; Taylor, 2020) but not reduce exposure, although some do have special clauses where they can rebuild elsewhere (Taylor, 2020). Therefore, policy holders raise their driveways, build sea walls and other hard infrastructure that passes risk to others

outside that pool (Cooper & Pilkey, 2012; Taylor, 2020) and this allows them to remain in risky locations and still retain their property value.

These ILS products deliver a high return which attracts investors (Johnson, 2015). These high returns also deliver returns for (re)insurance through their investments. In fact, if the high value, high risk properties reduced their exposure they would no longer deliver the high premiums and would not be useful as a ILS product. The more risk that is concentrated in one location the more liquidity is required to cover a potential disaster. With catastrophic modeling the industry can put a risk value on the ILS products and thus insure these high value, high risk properties (Johnson, 2015). Because more liquidity is required, (re)insurance seeks out these high risk, high value properties, creating a feedback loop which “feeds” on itself known as a reinforcing feedback loop. The feedback loop is strong because insurance is highly attracted to lucrative markets and will develop new rules and alternative financial products to enhance their ability to profit from risk (Johnson, 2015; Rohland, 2012)

A similar process occurs whenever risk exposure is not reduced, albeit more slowly when high risk, high value properties are absent. Basically, the destruction of capital that some skeptics discuss (Johnson, 2015; Taylor, 2020), is the conscious act of avoiding exposure reduction which makes insurance a viable financial product. Reducing sensitivity enables policy holders to remain.

Similarly, increasing generic adaptive capacity provides capital for other activities that otherwise would be locked up in risk management. However, there is no guarantee that this capital will be used for climate adaptation. In fact, this capital may enable a greater wealth accumulation which continues the need for insurance. Exposure reduction, however, does neither of these.

The insurance part of the loop is broken/removed but the program rules restore the reinforcing feedback loop as long as the crops or whatever is being insured is a cash crop and lucrative.

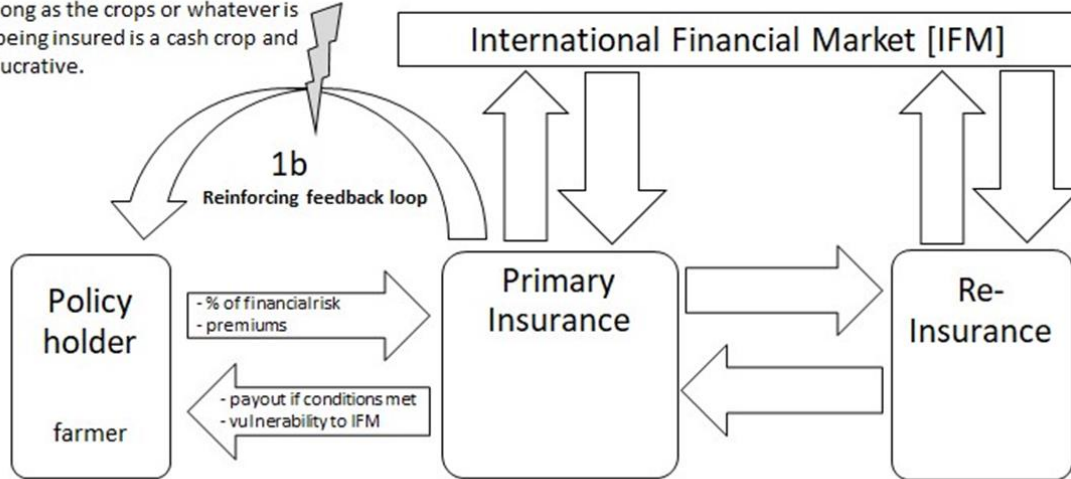


Diagram 4: Simplified stock and flow diagram of weak reinforcing feedback loop. The policy holder is a farmer. The literature does not signal whether the policy holder in this reinforcing feedback loop passes any financial vulnerability to the primary insurer or any other networked layer.

As mentioned earlier, parametric insurance breaks the insurance-policy holder feedback loop. However, the agricultural policy holders still land in a reinforcing feedback loop, albeit a weak one because of the program rules. The rules could keep the feedback loop balancing but instead the rules push lucrative crops or lucrative manners of farming or herding which alters the balancing to a reinforcing feedback loop. The program provider, which normally includes reinsurance as a partner and often multiple other financial institutions, sets the rules based on the program goals. These goals, then pressure the policy holder to take measures that enable profit such as fertilizers and farming larger tracts of land (Adegoke et al., 2017; Hochrainer et al., 2009; Müller et al., 2017; Osgood et al., 2008) which functionally reduce sensitivity but do not reduce exposure. In addition, reducing sensitivity in one location through the built environment or through fertilizers or heavier land use in agriculture can and does pass vulnerability to others (Adegoke et al., 2017; Hochrainer et al., 2009; Müller et al., 2017; Osgood et al., 2008; Taylor, 2016). Reducing sensitivity can also induce actions which ignore long-term impacts and

exposure, at least temporarily (Müller et al., 2017; Taylor, 2016). Just as in the indemnity reinforcing feedback loop, exposure reduction is avoided to maintain the, at least temporarily (Müller et al., 2017; Taylor, 2016), increased financial wealth.

The impact that local policy holders can have on the international (re)insurance industry through the reinforcing feedback loop only appears to be recognized in a limited manner. One author discusses the impact that San Francisco policy holders had in 1906 on reinsurance and on the global financial market (Rohland, 2012). The policy holders were able to pressure insurance to include fire caused by earthquake and then, later reinsurance rewrote its policies on earthquakes so it could remain in the lucrative San Francisco market (Rohland, 2012). The other example which is present in the literature is residential ILS in Florida. The reinforcing feedback loop, especially in the case of ILS, not only could but does impact the global financial order. If the reinforcing feedback loop is weak as in the case of focusing on reducing sensitivity and increasing generic capacity for non-high value, non-high risk properties or agriculture, it may also do so but this is not signaled in the literature.

Also fully missing from the literature but clearly signaled through CAS is the lack of diversity and redundancy. Insurance only connects to itself. Neither the literature about Florida nor the literature from the agricultural insurance adaptation cases discussed the notable fact that insurance did not consider other forms of risk management. Diverse types of risk management enable a system to respond to different shocks; the main idea behind the value of response diversity in resilience (Elmqvist et al., 2003). Insurance is fully lacking this response diversity. In addition, it is not supporting response diversity in the form of adaptation by its policy holders either. None of the current feedback loops mentioned in the literature connect other forms of risk management with insurance.

2.7 Discussion – ability to influence

(Re)insurance uses rules, premium prices and availability of insurance to pressure policy holders (Hecht, 2007; Ward et al., 2008; Suarez & Linnerooth-Bayer, 2010; Hochrainer-Stigler & Hanger-Kopp, 2017). This pressure influences policy holder choices surrounding whatever is insured, and in many instances what kind of risk management the policy holder relies upon (Botzen, 2013). In most insurance literature this reliance is considered good (i.e. Arena, 2008; Liedtke, 2007), even desirable for the functioning of the whole economy (Arena, 2008). This direct pressure, however, is not the only influence that (re)insurance has. Because of (re)insurance's connections to itself it enables policy holders to disconnect from other forms of risk management and rely on insurance or risk management forms that depend on insurance (Cooper & Pilkey, 2012; Taylor, 2020; White et al., 2001). Furthermore, (re)insurance incentivizes certain types of knowledge and ways of knowing (Grove, 2012; Lobo-Guerrero, 2010). Once present, (re)insurance values this information above other types of information, thus creating another form of influence.

Both advocates and skeptics recognize this influence. The difference is that advocates view this influence as valuable. The influence can drive policy holder choices (Hecht, 2007) not just building material and construction design choices in Florida but also crop choice and fertilizer in the agricultural cases (Adegoke et al., 2017; Panda et al., 2013; Suarez & Linnerooth-Bayer, 2010). Basically, if insurance can pressure policy holders to build in certain manners (Hecht, 2007; Ward et al., 2008) and can pressure farmers to plant certain crops for cash economy (Suarez & Linnerooth-Bayer, 2010; Schäfer et al., 2016) then insurance can pressure them to adapt. This ability to pressure is the primary reason that InsuResilience and other insurance programs are able to claim that their insurance programs will support climate adaptation by building adaptive capacity through conformance with insurance requirements. In Florida, this is the primary driver of reduction of sensitivity to events (FEMA, 2017; Ward et al., 2008).

How (re)insurance uses this influence demonstrates the goals of the system. (Re)insurance wants to make a profit, for multiple reasons. The rules that limit sensitivity to climate events and the rules that build adaptive capacity both serve this profit motive. By increasing adaptive capacity, policy holders are able to build larger homes in Florida which means they will then need more insurance, and policy holders in agricultural programs are able to invest in riskier but more lucrative crops (i.e. ground-nut in Africa and bananas in St. Lucia). Furthermore, reducing sensitivity protects the insurance provider from adverse selection and/or moral hazard.

Depending on the manner that insurance exerts its influence the feedback loop will be stronger or weaker. If it is strong, the loop will minimize physical risk sensitivity and build adaptive capacity through lucrative activities or lucrative property values. If it is weaker it will either partially address sensitivity and adaptive capacity or fully address sensitivity and adaptive capacity but in a less lucrative manner. However, index insurance provides the means for the primary insurance provider or the insurance programs (reinsurance) to avoid this influence. Index insurance breaks and undermines the balancing feedback loop (Diagram 4). (Re)insurance no longer has the immediate, direct incentive to limit adverse selection nor to limit moral hazard which means there is no need for (re)insurance to directly pressure any climate adaptation. (Re)insurance can still force policy holders out of the pool through pricing but this is no longer tied to what the policy holder does but to catastrophic models and index triggers which are disconnected from local adaptation (Johnson, 2015; Müller et al., 2017).

One of the consequences is that policy holders with insurance who are in the 1b feedback loop become disconnected from the environment in which they live. In Florida these are high risk, high value property enclaves that build private dams and raise private streets which in turn alter exposure risk for others in their geographical location (Cooper & Pilkey, 2012; Taylor, 2020). It is well known that coastal sea walls reduce sand next to the sea wall and therefore reduce wave protection, that levees and dams along rivers exacerbate flooding in non-dammed/leveed areas and that dikes, sea walls and dams alter sediment and water flow, to the detriment of other

locations (Cooper & Pilkey, 2012). By altering the environment, these high risk, high value properties can remain in a high risk, high exposure location delivering premiums to (re)insurance or investments to the financial market (Cooper & Pilkey, 2012; Johnson, 2015; Taylor, 2020). Essentially, insurance enables more accumulation of wealth which enables more insurance and less connection to building-location because of insurance.

This reinforcing feedback loop in combination with the balancing feedback loop are what produce contradictory policy outcomes at the local level. One feedback loop (1a) drives buy-outs and relocations while the other (1b) drives the development in those same floodable locations in the United States, including in Florida.

The reinforcing feedback loop also drives the local to global impact. ILS products based on high risk, high value properties are attractive investments for those who want a high return. This in turn motivates (re)insurance to insure more of these locations and place them in ILS products to provide for the now necessary liquidity due to the geographical concentration of risk. The more ILS products and high value, high risk locations insured the greater the liquidity is required, especially within climate change. The micro-correlations between events and fat-tails are some of the greatest challenges for insurance with climate change (Kousky & Cooke, 2009) and these geographically concentrated pockets of risk only increase each of these challenges. This increases the potential impact that these locations have on (re)insurance and the global financial market. (Re)insurance desperately needs greater spread in the form of more global policy holders (Johnson, 2015; Medders, 2017). Speculatively, this could be one of the reasons (re)insurance is so enthusiastically participating in climate related insurance programs such as agricultural climate adaptation insurance and InsuResilience. If so, then local ILS pockets are having an enormous impact on the global liberal order. Furthermore, Johnson (2015) has noted that ILS products are conspicuously similar to the mortgage backed securities crisis. A global financial crash such as that instigated by the mortgage backed securities, would be a huge impact on the liberal global order.

These two feedback loops also provide alternative manners to view insurance. Using various social and political theories on power as lenses would shed light on the power relations that (re)insurance has over policy holders. The inverse would also gain from social and political theories on power. Are those who use ILS products as insurance consciously exercising the reinforcing feedback loop and therefore influencing the global (re)insurance industry and the global financial market? Taylor (2020) implies that there is some conscious action by those involved in the residential ILS industry to influence at least where risk lodges.

Despite the challenges posed by insurance entering the reinforcing feedback loop, (re)insurance's influence can also be seen as a means to find solutions to the adaptation gap (Suarez & Linnerooth-Bayer, 2010). If insurance is used in this manner, which insurance for adaptation advocates clearly desire, then those pushing adaptation should consider insurance as a form of governance.

Furthermore, the agricultural cases are all some form of public-private partnership. Thus, social contract theory and theories of democracy and legitimacy all provide potential insights. Likewise, if the skeptics of insurance for adaptation are correct, then many of the outcomes are unsustainable which invites sustainability studies and migration studies and stranded asset/waste clean-up when the insurance providers leave the market.

When (re)insurance believes that there is not enough profit to be made, it will leave. In (re)insurance the talk is about the moral hazard of policy holders (Ben-Shahar & Logue, 2012) and limiting adverse selection. Ironically, the high value high risk properties in Florida that are in the reinforcing feedback loop are ignored and even lauded as providers of liquidity (Johnson, 2015) despite their moral hazard as far as exposure is concerned. The agricultural cases also provide examples of insurance moving policy holders into the reinforcing feedback loop. Planting a highly weather sensitive cash crop such as bananas or groundnuts embodies moral hazard.

However, as already discussed, index insurance can ignore moral hazard. Similarly, adverse selection is not interesting in either Florida's or the agricultural cases that are in the reinforcing feedback loop. In fact, adverse selection seems to be one of the defining criteria of the ILS products.

Eventually, however, adverse selection and moral hazard will impact global (re)insurance as discussed, (re)insurance will drop these properties or will relocate the owners if this is in the contract, leaving the built environment consequences of these properties to the local government. Similarly, eventually policy holders in the agricultural cases will deplete their environment, get hit by the volatility of the international financial market or succumb to the unaddressed climate exposure. When any of these things happen, they will be dropped by (re)insurance or forced to move or seek other livelihoods (Suarez & Linnerooth-Bayer, 2010).

However, what happens if policy holders are dropped? Diversity is largely ignored. A few skeptics do base their arguments on a switch to cash crops and fertilizer which reduces long-term sustainability and creates vulnerability to the international financial market (Osgood et al., 2008; Panda et al., 2013; Peterson, 2012). However, in CAS, diversity is valuable in and of itself as a provider of resilience. Diversity enables a system to respond to shocks (Elmqvist et al., 2003; Walker & Salt, 2012). When one approach is wiped out there are other manners to respond. The (re)insurance industry has many organizational forms, but the ultimate product is the same type of risk management. Florida does not have many, if any, serious formal risk management strategies outside of insurance. Thus, if (re)insurance fails or chooses to leave the market, there is nothing to take its place other than government disaster aid or other government relief (Johnson, 2015) if available. Many communities in the agricultural cases will have other forms of risk management but these are absent from program discussions.

This may not be so odd considering the information requirements of insurance are centered on actuarial science, catastrophic modeling and participating in the international global economy.

Insurance requires an enormous amount of knowledge and knowledge in a specific form to do this. However, it does create a “monoculture’ of risk management.

2.8 Conclusion

(Re)insurance is only one of the elements in global climate change adaptation, however, it is an important one. One that has both global actors who influence local adaptation choices and local actors who influence global actors, rules, definitions of risk and financial choices.

Advocates and skeptics of insurance in the adaptation context are often approaching adaptation from different perspectives. Advocates are focusing on increasing generic adaptive capacity through access to the international financial market and often reducing sensitivity to climate events. Skeptics focus on the vulnerability that comes with a direct connection to the financial market and the lack of exposure reduction when insurance is adaptation or drives adaptation.

Interestingly, both focus primarily on one feedback loop in the system, the balancing feedback loop in diagram 1a. However, with a CAS lens, it becomes apparent that there is more than one information feedback loop operating in this space. Furthermore, the balancing feedback loop which most of the literature bases its arguments on has varying strengths and is broken by parametric insurance. The break can be “restored” through other measures, but it is no longer insurance which is driving the adaptation.

These multiple feedback loops have consequences for how insurance functions in the adaptation context. Not only does global (re)insurance impact local adaptation, the goal of most insurance climate adaptation programs and arguments for insurance for adaptation, but through the reinforcing feedback loop, especially ILS, local adaptation can also influence the global (re)insurance industry and even the entire global financial market. These two feedback loops also can drive the contradictory land use policies at the local level, such as the demand for buy-

outs in floodable areas while simultaneously those same floodable areas are seeing an increase in new development of the built environment.

The CAS lens also reveals multiple alternative manners to view insurance in the adaptation space which enhances our understanding of the impacts of insurance on climate adaptation and provides solutions to some of the vexing issues raised by the skeptics while enabling (re)insurance to provide the climate adaptation that the advocates desire.

Using a CAS lens, this article focused on the information feedback loop that drives adaptation in insurance. There are many other insights a CAS lens could provide. For example, future work will examine the structure of how the network provides insights and examining the connections between the balancing and reinforcing feedback loop will provide insights. Delving deeper into the risks and vulnerabilities that flow between the stocks will also provide more insight into risk transfers and displacements. Moreover, these same feedback loops provide opportunities. Government regulations, (re)insurance rules and procedures and international insurance program rules all could modify how both feedback loops operate. With modifications the reinforcing feedback loop could be corralled back into a balancing feedback loop, and with the correct modifications the balancing feedback loop could generate the types of adaptation many hope for.

This article provides the first step into this space and opens many questions. For example, how do ILS products in developing countries impact the adaptation options of the rest of the country? Important for the Caribbean, how do high risk, high value coastal properties impact the ability of the rest of the coastal inhabitants to adapt? And, in the United States, how does the NFIP impact the provision of private insurance of all types for high value high risk locations that are not insured through the NFIP? To provide the necessary climate adaptation, these questions need examination. A CAS lens brings additional insights to current discussions and simultaneously invites other approaches to fill in the gaps discovered through the CAS lens.

CHAPTER 3
GOVERNING CLIMATE CHANGE ADAPTATION THROUGH INSURANCE: A RISKY
BUSINESS?

Abstract

Adaptation to the many hazards caused or exacerbated by climate change has been slow. Multiple international organizations view insurance as a means to pressure and to procure this lagging and missing adaptation. Insurance does have the ability to shape adaptations to hazards and has been called a regulator and governor of that which it insures. This article investigates how insurance functions as governance; why recognizing insurance as governance matters; and how insurance could be governing climate change adaptation and what the consequences might be. To tackle this last question, the article builds a structural assessment tool to use the growing body of theoretical and empirical literature on insurance as explicit and implicit governance to critically examine the potential implications of insurance governing adaptation. The analysis reveals that relying on insurance in the adaptation context presents four key concerns. Insurance 1) reduces financial risk for some but does not necessarily reduce vulnerability; 2) may cause risk displacement within and outside of risk pools; 3) will structure climate change adaptation to the demands of indemnity and index insurance which could have long-lasting unintended consequences and could enhance telecoupling issues already in play through globalization; and 4) may unintentionally shift authority over adaptation away from governments to private insurance companies and other non-state actors. Despite these concerns, because insurance can and does govern, if insurance governance tools are used to specifically focus on adaptation to the changing climate, insurance still may be one of the better means to promote climate change adaptation.

3.1 Introduction

Despite widespread recognition of climate change, adaptation to the many hazards caused or exacerbated by the changing climate has been slow. Multiple international organizations are

concerned about this lack of adaptation and have turned to insurance as one manner to address the adaptation gap both as a form of adaptation and to drive adaptation. This research refers to both as insurance for adaptation. This turn to insurance makes sense. Insurance has a long history in international climate change agreements, beginning with the first United Nations Framework Convention on Climate Change (UNFCCC, 1995) and, currently, is named in the Paris Agreement (UNFCCC, 2015). However, questions remain about what insurance for adaptation means, and what the consequences may be (Müller et al., 2017).

Simultaneous to the development of an adaptation gap and the calls for insurance for adaptation, scholars in various fields have begun to recognize insurance as a form of governance, albeit often non-governmental (Ben-Shahar & Logue, 2012; Chhotray & Stoker, 2009; Pierre & Peters, 2000). However, the literature has not deeply investigated how and with what tools insurance governs nor explicitly combined insurance as governance with insurance for climate change adaptation.

This article first examines how insurance governs and with what tools this governance is operationalized. These insurance governance tools form the basis for a structural assessment. Next this article adds the critical questions inherent to climate change adaptation to complete the structural assessment to capture the potential impact of insurance on adaptation. The article then analyzes the potential impacts.

3.2 Materials and Methods

Materials

This research used peer reviewed literature on climate change, climate change adaptation, insurance and governance, as well as legal texts, law review articles on insurance and insurance as a regulator, treatises on insurance and insurance textbooks. In addition, the research used illustrative cases in historical environmental geography which discussed insurance impact, influence or lack thereof. The illustrative case from Sundsvall, Sweden was about how insurance

could impact adaptation in general, how the definition of risk could change and, especially, how catastrophic fires in cities were intimately linked to the larger environment (Rohland, 2011a).

Methods

The methodological approach begins with a literature review and synthesis of climate change adaptation, governance, insurance and insurance as governance. I coded the insurance and insurance as governance literature for all insurance requirements that were necessary for the insurance provider to survive and, in the case of most private companies, make a profit. Then I coded all tools which insurance uses to fulfill these requirements and compiled these tools into six categories.

Next, I added critical adaptation questions to each tool. Recognizing that insurance can and does govern and operationalizing which tools insurance uses for this is not enough to critically examine climate change adaptation. Adaptation is complex (Nelson et al., 2007), often contains trade-offs (Adger et al., 2005; Erikson et al., 2011), depends on the reduction of vulnerability (Nelson et al., 2007; Smit & Wandel, 2006), and must address for who, what, when and where to analyze where the benefits and costs are accruing (Eriksen et al., 2011; Meerow & Newell, 2016). The insurance tools in concert with the adaptation questions form a structural assessment for investigating what the impacts are or could be of insurance for adaptation in a specific situation.

Then this article illustrates the structural assessment using a detailed historical case on the role of reinsurers already in the literature, augments this illustration in the discussion with other examples from the literature and then provides a glimpse into what the potential impacts may be.

3.3 Literature

It is widely recognized that insufficient climate mitigation is resulting in substantial adaptation needs. The Intergovernmental Panel on Climate Change defines adaptation as “adjustment in natural or human systems in response to actual or expected climactic stimuli or their effects,

which moderates harm or exploits beneficial opportunities” (IPCC, 2014), which encapsulates the breadth of possible actions that could be considered adaptation. Basically, adaptation is supposed to avoid or lessen the impacts of climate change (Adger et al., 2005). However, even adaptation that appears successful can have negative impacts (Eriksen et al., 2011). What the individual, organization or society is adapting to; who will decide for whom; when and how, where and why dramatically influence adaptation outcomes (Eriksen et al., 2011; Meerow & Newell, 2016).

These questions are complicated by the reality that adaptation occurs at different scales and involves the actions of multiple heterogeneous actors (Adger et al., 2005). For instance, some forms of adaptation may try to change specific, local conditions or capacities while others could be aimed at system-wide shifts or general adaptive capacities designed to enable broader suites of local adaptations (Eakin et al., 2014; Lemos et al., 2016). Recognizing the complexities of adaptation is a precondition for thinking about adaptation implementation.

One of the mechanisms that the international community has embraced is insurance. Insurance is particularly interesting because it involves actors at multiple levels, from the very local through to the global, and those actors are within and outside official governmental bodies. Moreover, insurance has been part of the climate change discussion since the beginning when Decision 11/CP.1 specifically included insurance as an adaptation measure (UNFCCC, 1995). Soon after, insurance companies joined those in the adaptation community who were pushing for a greater emphasis on adaptation (Linnerooth-Bayer et al., 2003) and in 2005, the Stern Report (Stern et al., 2006) promoted insurance as a strategy for adaptation.

Many in the international community assume that by using insurance, a risk transfer will occur which reduces vulnerability (e.g. InsuResilience, 2017; Schäfer et al., 2016; InsuResilience, G7, 2015). In simple form, if people are insured, they will be able to recover faster after disasters without losing all their resources. Because they are better off financially they will be able to adapt

to the changing climate (Suarez & Linnerooth-Bayer, 2010). In addition, insurance will force people to take climate change into account when making decisions (Suarez & Linnerooth-Bayer, 2010).

However, others, such as Sarewitz et al. assert that, “risk-based approaches to covering the costs of extreme events do not depend for their success on reduction of vulnerability (2003: 805).” Indeed, White et al. and others argue that many actions and programs intended to reduce risk have failed to produce intended results and, in some cases, have even increased losses (2001; Montz et al., 2017). Climate insurance may also suffer from this same paradox (Müller et al., 2017). Furthermore, risk, which insurance is based upon, is a socially constructed phenomenon and is negotiable, including “objective” risk assessments (Douglas & Wildavsky, 1983; Rohland, 2011b) and not all people will benefit equally from adaptation (Eriksen et al., 2011; Meerow & Newell, 2016). Such arguments challenge international assumptions about how insurance will work in the context of climate adaptation and raise questions about the types of adaptation insurance leads to, how insurance drives adaptation, and who is carrying the risks. It is in this context that we need to examine insurance as a form of governance.

As environmental governance has become a focus of study, scholars have increasingly investigated the ability of non-state actors to serve in governance roles and to impact the functioning of legal governmental systems (Chhotray & Stoker, 2009; Ostrom, 2009; Ostrom et al., 1961; Pierre & Peters, 2000). Insurance is one of the non-state actors of interest (Ben-Shahar & Logue, 2012; Ericson et al., 2003). However, insurance is not only private; it can be purely public or part of a public-private partnership, as with the National Flood Insurance Program. Therefore, insurance as a form of governance spans both traditional governance and non-governmental governance. Ostrom has extensively researched the impact of rules (Ostrom et al., 1961; Ostrom, 2009), and, insurance rules have been recognized as a form of governance (Ben-Shahar & Logue, 2012; Botzen, 2013; Ericson et al., 2003). However, how exactly insurance fits

into governance literature, what tools insurance uses to govern, and how this all fits with climate change adaptation has not yet been extensively analyzed.

Insurance is a form of risk management, where risk is transferred from the party buying insurance to the insurer; the individual or organization buying the insurance pays a premium, and, in the event of loss the insurer provides a certain, agreed upon, financial compensation (Rejda & McNamara, 2013). Insurance is based on risk pooling. The contributions of a large number of participants pay the losses of the few in a given time period (Plitt et al., 1995-date; Rejda & McNamara, 2013). Actuarial methods used to compute premiums through statistical probabilities and harms underpin insurance (Ben-Shahar & Logue, 2012). These computations must take into account interdependencies and correlations and must be definite and measurable (Rejda & McNamara, 2013). If the events are unintentional and accidental, there is no correlation between the various risks, the events are independent, and there are enough participants, the insurance agency can predict the loss (Rejda & McNamara, 2013). Through measurement and predictability insurance companies guarantee a profit and/or minimize losses, cover potential loss, maintain spread and, avoid correlation and interdependence (Ben-Shahar & Logue, 2012; Rejda & McNamara, 2013). These aspects of insurance are absolutely necessary for insurance to exist.

In addition, insurance companies must have enough liquidity to cover a catastrophe, normally through a combination of reinsurance, having enough capital at hand, and investments on the financial market (Cook & Dowlatabadi, 2011). However, even reinsurance mechanisms can fail for the largest disasters if there are not enough liquid assets (Michaels et al., 1997). One solution is to transfer risk internationally (Michaels et al., 1997:225). Many insurance companies are turning to the international financial market using multiple risk transfer tools such as index-linked securities, weather derivatives, catastrophe bonds, and regional risk-pooling (Johnson, 2014; Michel-Kerjan, 2010). Indeed, this approach to liquidity is what the insurance market in Florida depends on (Medders, 2017).

Furthermore, since most insurance companies are for-profit, the premium must be high enough to guarantee a profit (Ben-Shahar & Logue, 2012) otherwise the company will leave that specific insurance market calling that risk uninsurable (Cook & Dowlatabadi, 2011; Ward et al., 2008). However, some premiums are underpriced causing a phenomenon called risk displacement. Risk displacement is a form of risk transfer, where the policy holder passes risk to the rest of the pool without paying the accurate price of the risk. The transfer is either one where those with higher risk transfer their risk to the rest of the lower-risk pool, or, where risk is moved to a different networked layer, such as the international financial market (Sturm & Oh, 2010). As demonstrated by Selmier and Winecoff, risk can transfer not only within a pool and to different networked risk layers but also to the larger public (2014).

Insurance must also address moral hazard which is the indifference to loss or disinterest in reducing loss because of the presence of insurance (Ben-Shahar & Logue, 2012; Rejda & McNamara, 2013). In the literature this is normally only attributed to indemnity insurance which is insurance that restores the policy holder to the approximate financial position prior to the loss. It is directly connected to the actual financial damage that has transpired (Rejda & McNamara, 2013). Index insurance is not tied to the actual losses but instead is triggered by the crossing of some threshold, typically wind speed, amount of rain or dryness of soil (Johnson, 2013). Index insurance is supposed to avoid moral hazard because it is not as tightly coupled to the policy holder's choice to reduce risk. However, index insurance may increase the moral hazard of the insurance company because the coupling between the policy holder's loss and the insurance company's profit margin is reduced. The lack of coupling removes any profit-reason for an insurance agency to influence the risk of its policy holder. This potential issue is not discussed in the literature on insurance for climate change adaptation. Regardless of the difference between indemnity and index insurance, moral hazard has a large academic presence (Ben-Shahar & Logue, 2012) and insurance uses multiple tools to reduce it, therefore it must be considered when examining insurance. Copayments and deductibles are intended to reduce moral hazard; in fact, insurance companies work with their exposure units to reduce risk, thereby decreasing the loss

that the insurance agency would have to cover (Ben-Shahar & Logue, 2012). Reduction of moral hazard, profit motive, measurability, predictability, avoidance of correlation and interdependence, and liquidity all provide an incentive for the insurance company to govern the actions of those who it insures.

Governance directs the actions and conduct of a multitude of actors with authority; in an ordered and intentional manner; proclaiming a specific social function with goals of a public nature; aimed at governing societal problems and creating opportunities; with a range of institutions and relationships in multiple forms (Chhotray & Stoker, 2009; Huitema et al., 2016; Pierre & Peters, 2000; Young, 2017). The international calls for insurance for adaptation broadcast and proclaim a specific societal function of pushing non-adaptation and slow adaptation toward the socially desired outcome of more and faster climate change adaptation for the poorest and most climate vulnerable (Linnerooth-Bayer & Hochrainer-Stigler, 2015; Schäfer et al., 2016; InsuResilience, 2017), which aligns seamlessly with the characteristics of governance activities.

In addition, Djelic and Sahlin-Anderson, state that, “Even though many rule-makers do not have the type of regulatory authority traditionally associated with states, they can develop and structure regulatory sets that can be more or less coercive for example, through the connection between certain rules or standards and access to membership, resources or certifications (2006:8).”

Insurance does all of these. Insurance intentionally directs the actions of actors ranging from drivers, to homeowners, (Ben-Shahar & Logue, 2012), to cities rebuilding after disasters (Rohland 2011a) to sovereign governments (Grove 2012). Insurance can require policy holders to reduce their risks and provide information, refuse coverage, increase premiums, maintain technical expertise and have direct access to the specific individuals that it insures (Ben-Shahar & Logue, 2012; Ericson et al., 2003; Hecht, 2007; Ward et al., 2008). The industry has authority both directly and through the market. For instance, federal and state laws require auto insurance, but the insurance company determines rates, gathers information, and sometimes lobbies the government for better or different safety legislation (Ben-Shahar & Logue, 2012). Likewise,

international agreements regarding environmental waste and toxic substances in shipping are not implemented by any traditional governing body but by Protection & Indemnity Clubs which regulate prices, manage compliance and enforcement, and penalize those who violate the agreements (Bennett, 2001). In addition, insurance companies pressure governments to enforce regulations (Huber, 2004). Through implementation of its rules, insurance often fulfills, both implicitly and explicitly, public goals aimed at governing societal problems (Ben-Shahar & Logue, 2012; Botzen, 2013; Ericson et al., 2003; Mechler et al., 2014). Society wants vehicle operators to be insured, homeowners to cover potential losses, companies to be responsible for the toxic substance they use and transport, and cities and towns to be able to rebuild after disasters.

3.4 Results

Based on the insurance as governance literature (Ben-Shahar & Logue, 2012; Ericson et al., 2003), basic insurance principles (Botzen, 2013; Mechler et al., 2014; Michel-Kerjan, 2010; Rejda & McNamara, 2013) and case studies of insurance in the literature (Bennett, 2001; Botzen, 2013; Lobo-Guerrero, 2010; Rohland, 2011a; Rohland, 2011b) this research has qualitatively coded six specific tools that operationalize insurance as governance. These tools are what support or impede adaptation on the ground. The basic tools that the insurance industry uses are: risk reduction, increase in premiums, refusal to insure, information/data gathering, pressuring governments to enforce regulations or take measures, and, requiring a link between the insurance and the biophysical risk. The tools form the first piece of the insurance as governance structural assessment for understanding insurance for adaptation governance. **See Table 1 in Appendix B.**

Each of the tools support the necessary elements of measurability & predictability, covering potential loss & providing liquidity, maintaining spread and avoiding correlation, and protecting profit or limiting loss if non-profit or public. This occurs at multiple scales both for insurance

providers and policy holders in all forms of insurance ranging from purely private to fully public. Concurrently, these same elements govern what actions and choices policy holders make (table 1).

However, as widely acknowledge in the adaptation literature, it is essential to ask questions about the distribution of risks and benefits that these forms of governance would entail (Eriksen et al., 2011; Meerow & Newell, 2016). Furthermore, risk is a societal construct that omits some risks and focuses on others in risk assessments (Douglas & Wildavsky, 1983) including the insurance definition of objective risk (Rohland, 2011b). Therefore, this research adds who, for what, where and why to the structural assessment. This addition enables an analysis between the tools that insurance uses, insurance for adaptation policies, projects, programs or proposals and the actual on-the-ground local-level adaptation implementation. Specifically, it will allow decision makers to better consider the consequences of the various insurance programs, the trade-offs between policies, programs, proposals and where the risk may lodge, through inclusion or omission.

This research illustrates the use of the structural assessment tool and the need to consider the critical questions from adaptation using a specific historical case. If one only uses the tools without the adaptation questions it is possible to deconstruct which tools insurance was using to govern. When one adds the adaptation questions one gains extensive analytical leverage. Not only is the specific insurance governance tool visible but also the potential or, in the case of Sundsvall, actual consequences of that specific governance tool (table 2).

The entire example in the illustration comes from Rohland (2011a). In 1888 during unusually dry conditions in Sweden the city center of Sundsvall burned to the ground apart from a couple of buildings which were built in stone. The insurance industry, both Swedish insurers and international reinsurers, suffered large losses. In response, a group of reinsurers, including the Swiss Reinsurance Company [SRC], wrote new rules for reinsuring insurers who insured cities which were built in wood and individuals living in wooden homes. This rewriting of risk went so

far as to consider refusing insurance to insurers who insured cities where 100% of the buildings were wooden. The final rules capped reinsurance for wooden cities at 25% of loss if 50% or more of the buildings were wooden. To keep their reinsurance, reduce the premiums on the reinsurance and to minimize losses in the future, the Swedish insurance companies required Sundsvall to rebuild in stone to retain their insurance. Until Sundsvall was rebuilt in stone, the city would pay extremely high premiums. Individuals were also required to rebuild in stone if they rebuilt in the city center. As a consequence, the poor and middle class that still lived in the city center now had to move. In addition, some of the Swedish insurance companies refused to insure any home built in wood, no matter its location. **See Table 2 in Appendix C.**

The insurance tools of requiring a risk reduction, increasing premiums and potentially refusing to insure all appear to drive a highly logical requirement within fire insurance: rebuild in stone. As Rohland (2011a) states, the insurance industry was learning through experience. If the critical questions of adaptation – what, who, when, where and why – are not included, this looks like a great example of insurance’s capacity to drive change. However, when these questions are included, the picture is less clear. Risk reduction for the reinsurance companies is good. Risk reduction and lower premiums for the Swedish insurance sector seems good. Risk reduction for the city center seems good, but, what about the risk, and vulnerability, of the middle class and poor who could not rebuild in stone, could not pay the higher premiums or were refused insurance altogether because they had to rebuild in wood?

Information gathering and pressuring governments to take measures also both appear to drive positive results for decreasing future fire disasters. Knowing which buildings withstood the fire, knowing that housing density impacts fire’s mobility and pressuring market towns and cities to use less wood all seem like good ideas. However, both are less clear-cut when the adaptation questions are added. The information does not contain demographic data which makes sense from the reinsurer’s perspective but may have been important if the city had wanted its workers and artisans to have easy access to markets and other industry in town. Reinsurers could also

have pushed for better fire brigades but did not even though, according to their reports, it was one of the reasons the fire got so out-of-hand (Rohland, 2011a).

The coupling between insurance and the biophysical was not directly mentioned by the (re)insurance companies in this case study, except by the author. Rohland used the Sundsvall fire, along with several other points, to demonstrate that fire, also in cities, is connected to the larger environment and that insurance could, in fact, be a driver of adaptation to climate change (2011a).

3.5 Discussion

The ability of insurance to govern is clear. However, as shown in the results, insurance as climate change adaptation governance does raise ambiguities and potential concerns connected to whose risk is reduced, for what, when where and why. These concerns stem from the lack of connection historically and analytically between risk in insurance and vulnerability reduction (Sarewitz et al., 2003; White et al., 2001); spread and liquidity issues and therefore risk displacement; in the case of indemnity insurance, moral hazard; and, discussions of who should be determining what choices society makes. In addition, the adaptation questions provide insight into how risk is socially constructed and what unintended consequences that may have on society (Douglas & Wildavsky, 1983). These concerns can be divided into four primary categories: risk vs vulnerability, private risk displacement to public, structure according to needs of insurance, and shifting authority from governments to insurance companies or insurance partnerships.

Risk vs vulnerability

White et al. (2001) and Montz et al. (2017) explain that risk reduction schemes have not necessarily reduced vulnerability. They even have claimed that some risk reductions, including some insurance schemes, have increased financial losses and vulnerability. Sarewitz et al. argue that programs built on financial risk reduction for extreme events do not need to reduce vulnerability (2003). These arguments make complete sense from an insurance perspective.

Insurance is based on actuarial methods which do not include any vulnerability assessment; in fact, why would it unless vulnerability reduction will protect measurability & predictability, liquidity, spread, and ultimately profit (or no-loss for non-profit) that the actuarial methods protect.

The Sundsvall case illustrates this issue rather clearly. The risk that threatened the financial circumstances of the (re)insurance companies was reduced or removed through risk reduction measures, actual and threatened premium increases, actual and implied refusal to insure, information gathering on the disaster, and, pressuring Sundsvall, a wealthy market city, to rebuild in stone. The financial and fire risk for the city center was reduced through building in stone. However, the financial risk of those who had to rebuild in wood increased because their premiums increased, or they could not get insurance. Moreover, the vulnerability of the people who had to move to the edge of town potentially increased. They now live further from their place of employment, they had to use less-safe materials for building, especially considering their proximity to the dry forest, and the city, instead of investing to improve its fire brigades, lessened its risk through stone buildings. An improved fire brigade would have served all members of the community, while building in stone did not.

This same example also illustrates how risk is a social construct (Douglas & Wildavsky, 1983; Rohland, 2011a; Rohland, 2011b) therefore it could mask power asymmetries. The (re)insurance companies logically constructed risk according to their own business financial needs and desires. The city may have as well, but the individual policy holders had no role, unless part of the city government, in the definition of risk, even though these were the people who in the end, profited through less financial and fire risk, or paid the price through greater financial risk and potentially greater fire risk. This shifting of risk has a name, risk displacement.

Risk displacement

Desired risk transfer occurs when a policy holder transfers risk to the insurance pool but if this policy holder does not pay enough premium to cover the accurate price of the risk the transfer

becomes a displacement. Risk displacement also occurs when risk is displaced to a different networked layer such as the financial market (Stern et al., 2006) or to the larger public (Selmier & Winecoff, 2014). Many of the discussions on moral hazard, in fact, revolve around guaranteeing that a high-risk policy holder does not displace their risk to the insurance risk pool (Ben-Shahar & Logue, 2012: see p 199, footnote 3).

The Sundsvall case illustrates this shift of financial risk to more vulnerable populations. The middle class and poor had their risk increase and those on the edge of town may also have had their risk increase, due to their proximity to the forest. This shift is not unique. In 1906 the British insurance companies wanted to keep their lucrative position and insurance in San Francisco so they used their sterling reserves in London which then partially caused the global financial crash of 1907 (Rohland, 2011b). Essentially, the risk was transferred to the global market while the reinsurance companies kept the profit. Similarly, the SRC decided to stay in the San Francisco market after the earthquake and fire of 1906 but it did mean they had to increase their spread (Rohland, 2011b). Someone else had to be paying enough premiums to protect the company from another potential disaster in San Francisco. The relevance of risk displacement continues today, Florida is a good example (Medders, 2017) although it is written about in a more benign manner. Insurance companies are staying because the market is lucrative, but they are ultimately depending on States, and therefore taxpayers, to bail them out if it goes wrong (Johnson, 2014; Medders, 2017). The higher the risk the more lucrative the market (Johnson, 2014). In itself this should be a concern for insurance for climate change adaptation.

On a national scale the National Flood Insurance Program in the United States is known for its financial risk displacement from policy holders to taxpayers (Michel-Kerjan, 2010; Michel-Kerjan et al., 2012). This is what Selmier and Winecoff were talking about, taking private risk and transferring the risk to the public while the profits remain private (2014).

Structure according to needs of Insurance

Whether or not risk is transferred or displaced, moving risk from one insured layer to the global financial network is a structural reality for (re)insurance, partnerships and even public insurance. This structural reality raises the concern that insurance could structure climate change adaptation to the demands of indemnity and index insurance which could have long-lasting unintended consequences and could enhance risk displacement through telecoupling.

Some companies receive more earnings from their investments than their insurance premiums (Cook & Dowlatabadi, 2011). This telecoupling of local risk to the global financial market exists to guarantee liquidity if a large event occurs or multiple larger events occur simultaneously, to augment spread through premiums and protect profits (Cook & Dowlatabadi, 2011; Johnson, 2014). Although both Johnson (2014) and Cook & Dowlatabadi (2011) discuss this in the present, Rohland, demonstrates that this telecoupling already existed in 1906 with the San Francisco fire (2011b).

Moreover, telecoupling combined with the tools that insurance uses to guarantee its survival and maintain a profit can have unintended consequences. SRC and the other reinsurance companies surely had no intention of transplanting vulnerability from the center of the city to the outskirts of town nor did they desire to create segregation between the wealthy and the poor and lower middle classes. Likewise, it is difficult to imagine that the Swedish insurance companies had either of these consequences as goals. However, because of the insurance's dependence on actuarial methods, its need to guarantee its survival and maintain a profit, and the tools that it is using to achieve this, drove the transfer of vulnerability.

Insurance attempts to structure, intentionally and unintentionally, organizations and policy holders it interacts with to guarantee its business survival, and when for-profit, a profit. Completely logical, unfortunately in addition to telecoupling and unintended consequences this may shift authority from governments to insurance companies, partnerships or public insurance programs.

Shifting authority from governments to insurance companies or partnerships

Governance can be both public, private or a combination (Chhotray & Stoker, 2009; Pierre & Peters, 2000). O'Brien et al. raise concerns when private governance is involved because corporations, businesses and private non-profits do not have any responsibilities to citizens, nor can citizens remove them if there are problems (2009). This is particularly salient when discussing risk. Risk is a social construct (Douglas & Wildavsky, 1983) and insurance's definition is just as much a social construct as another risk definition (Douglas & Wildavsky, 1983; Rohland, 2011a; Rohland, 2011b). If climate change adaptation is beholden to current insurance definitions of risk, insurance for climate change adaptation may unintentionally shift authority over adaptation away from communities, cities and States to private insurance companies and other non-state actors.

SRC along with several other international reinsurance companies established new regulations that dramatically limited the maximum coverage for cities built in wood. This in turn "pressed them [Swedish insurance companies] to change their policy towards owners of wooden houses" (Rohland, 2011a:166). Only three years after the fire the entire city center was rebuilt in stone (Rohland, 2011a). Sundsvall could have instituted a better equipped and more capable fire brigade, but this would not have fulfilled the reinsurance's demands. Although the city could have said no and financed a better fire brigade, there would have been an enormous, and possibly impossible, price tag. The (re)insurance companies in the Sundsvall fire shifted authority away from the city to gain protection for their altered definition of risk. Non-state, non-local private organizations dramatically impacted local public choices – high premiums and fire brigade or rebuild in stone.

So although a community, city or State may value other risks or define risk differently than the insurance industry, once involved the insurance may override or redefine the communities version of risk or alter the communities version of risk to fit insurance's needs and goals.

Additionally, insurance may displace the local risk management methods. For example, in Sundsvall the insurance company choices may have influenced the city's decision to not invest in a more effective fire brigade (Rohland, 2011a). This does not always have to be negative. Many communities in the United States were not and maybe still are not enthusiastic about seatbelt laws. However, the insurance industry lobbied, using the pressuring governments governance tool, across the United States to get these instated (Ben-Shahar & Logue, 2012). Arguably, these laws have saved many lives.

In the case of climate change adaptation, however, local risk management methods may be more culturally appropriate or build better social cohesion, both of which are important for the fabric of the community when struggling with climate change. Likewise, dependence on a set of larger non-local corporations may not enhance legitimacy of climate change adaptation but undermine it. In fact, these issues are already playing out on a national level. In 2010 the Caribbean Catastrophe Risk Insurance Facility [CCRIF] paid out USD 8 million to Haiti which was a miniscule amount compared to the hundreds of millions of US dollars in costs to rebuild (Lobo-Guerrero, 2010) raising questions of legitimacy. Furthermore, CCRIF money spent in Jamaica created frustration among national disaster management personnel who are supposed to be implementing disaster response programs but are not included in CCRIF discussion and witnessed CCRIF money for rebuilding disappear into general funding (Grove, 2012).

However, if insurance uses its governance tools to enable adaptation by working with local communities, creating insurance products that not only serve the profit and risk spreading goals of reinsurance but also the self-regulating capacities of local communities, cities and States to adapt to the changing climate, the insurance industry could serve as an incredibly important driver for climate change adaptation, and, maybe even as climate change adaptation.

3.6 Conclusion

Due to these four concerns, insurance for adaptation may not be what the international communities hopes but instead what Müller et al. were concerned about, potential maladaptation (2017). However, Ostrom has demonstrated many times that the consequences of rules depend on the context (2009). If insurance rules are placed within a context which compels and enables the literal goals of the international calls for insurance for adaptation, insurance governance tools could transform traditional approaches to risk management, vulnerability and climate change adaptation. Recognizing insurance as governance and the tools it uses combined with critical adaptation questions in the structural assessment provides insight into how and what insurance tools need to achieve this innovative and transformational role. Furthermore, this research serves as a foundation to investigate what types of insurance rules produce which impacts or trade-offs in general, and specifically, to interrogate multiple adaptation contexts in which insurance drives policy holder choices.

However, important questions remain. Who decides what adaptation is appropriate? The reinsurance company protecting its profit and spreading its risk, the international insurance for adaptation program, the Nation-State, or the locals who must live with the changing circumstances? Whose risk definitions and risk management experiences do we value? How do we articulate and include the probable plurality of answers to these questions under the Paris Agreement? Finally, what do the answers mean for the growing adaptation gap, especially for those already experiencing the direct, physical consequences of climate change?

CHAPTER 4
LEVERAGING INSURANCE FOR CLIMATE CHANGE ADAPTATION: POSSIBLE CONCERNS
FOR JUSTICE?

Vanessa Lueck and Sonja Klinsky

Abstract

Insurance has increasingly been presented as an important element of climate adaptation. It is supposed to increase resilience, be a form of climate adaptation or drive adaptation, provide for disaster recovery to extreme climate events and in some cases provide for loss and damage. In light of substantial and growing climate impacts, understanding the influence of insurance on climate adaptation is imperative. However, the ability of insurance to shape policy holders' choices and thereby govern adaptation raises potential justice implications. Using a multi-valent approach to justice this article examines a suite of programs intended to support adaptation through insurance. This analysis demonstrates that although some programs clearly attempted to consider issues of justice, overall these existing programs raise several justice concerns and do not appear to fulfill international calls for insurance to either be a form of or to drive climate adaptation.

4.1 Introduction

As climate impacts are increasing, many in the climate policy space are turning to insurance to increase climate resilience, be a form of climate adaptation or drive climate adaptation (InsuResilience 2017; Schäfer et al. 2016). Attention to insurance has risen dramatically and efforts are already underway to develop insurance products designed to assist adaptation. However, a number of open questions remain, not least of which is what the long-term justice implications of using insurance as a form or enabler of adaptation will be. If insurance is to result in the desired outcome of protecting the most vulnerable from significant loss, understanding its justice implications is essential.

Insurance has been viewed as an appropriate approach to adaptation since the first United Nations Framework Convention on Climate Change (UNFCCC, 1995) and many have argued for it to be either a part of or used in support of climate adaptation (Schäfer et al. 2016; Stern et al. 2006). As a form of governance, insurance works by shaping the options and decisions of policy holders, and thus the ability to guide policy holders toward climate adaptation (Hecht 2007; Ward et al. 2008). Simultaneously, its power to shape decision-making has also raised concerns about the kinds of adaptation it will support, and what the justice implications of this will be (Knudson 2018; Taylor 2016).

This article examines the justice implications of using insurance as a form of governance to shape adaptation. It first presents an analysis of how insurance can be used as a form of governance, and then uses a multi-valent approach to justice to identify how these insurance programs included distributive, procedural and recognition justice elements. Three major findings emerged. First, as currently utilized in agricultural crop-insurance contexts, insurance may have limited capacity to enable adaptation to climate change. Second, there may be trade-offs between short and long-term distributive justice implications of insurance program design. Third, procedural and recognition justice have been sparsely documented, making empirical analysis difficult and highlighting the potential challenges insurance as currently implemented may pose for these justice dimensions. These findings raise pointed questions about the ability of insurance to function as adaptation and/or to drive adaptation.

4.2 Insurance as a Form of Governance for Adaptation?

Climate adaptation needs have grown in the past decade, are likely to continue growing, and can take many forms. The IPCC (2014) defines adaptation as “adjustments in natural or human systems in response to actual or expected climactic stimuli or their effects, which moderates harm or exploits beneficial opportunities”. Adaptation specifically includes local or community-based responses to the biophysical environment (Smit & Wandel 2006) and is supposed to avoid or lessen the impacts of climate change (Adger et al. 2005).

However, adaptation “can have negative unintended effects both on people and on the environments” (Eriksen et al. 2011:8) which triggers critical questions about justice: Who must adapt and who decides? When and how will an individual, organization or society adapt? Where will adaptation take place and what will influence adaptation outcomes (Meerow & Newell 2016; Eriksen et al. 2011)? Some adaptations could be aimed at local conditions while others could be aimed at reshaping whole systems. Likewise, some adaptations could be aimed at specific adaptive capacities pertaining to a single issue while others could be aimed at generic adaptive capacities such as improving financial assets (Eakin et al. 2014; Lemos et al. 2016).

A wide variety of actors have called for insurance to be used in support of adaptation, including ICLEI, UNEP and InsuResilience and it dates back to at least 1995 in the UNFCCC itself (UNFCCC 1995). By 2005 Munich Re had initiated the Munich Climate Insurance Initiative [MCII] which promoted insurance as a strategy for adaptation (MCII 2005), and insurance for adaptation was explicitly named in the Stern Report (Stern et al. 2006).

These calls assume that insurance will reduce vulnerability by transferring risk. The underlying logic is that individuals with insurance will not lose all their resources in a disaster which will enable them to recover faster. Insurance would also force policy holders to consider climate change when making decisions which could also reduce vulnerability (Suarez & Linnerooth-Bayer 2010; Schäfer et al. 2016; InsuResilience 2015).

However, the relationship between insurance and adaptation, in the sense of reducing vulnerability to climate change, is unclear. It is important to remember that insurance was devised in the thirteenth century to protect financial investments in risky undertakings, generate profit, and, later, maintain a lifestyle or function (Lobo-Guerrero 2010). In contrast, climate change adaptation is focused on changing behavior to adjust to biophysical circumstances, rather than facilitating risky undertakings *per se* or maintaining a lifestyle. From this perspective insurance

may be an awkward fit with the underlying goal of reducing vulnerability. For example, activities intended to decrease risk may aggravate situations, leading to claims that insurance “has probably increased not reduced losses” (White et al. 2001; 90). Financial gain, including from subsidies, can reinforce existing ineffective or mal-functioning systems (Anderies et al. 2006; Walker & Salt 2012). Further, while reduced vulnerability does mean reduced risk, reduced risk does not automatically reduce vulnerability. Vulnerability does not need to be reduced for a risk-based approach to succeed and vulnerability does not stem from extreme events, although these can and probably will exacerbate it (Sarewitz et al. 2003). From this perspective, risk reduction would not be adaptation *per se* unless vulnerability is also reduced.

In order to be able to identify how insurance is, or could, reduce vulnerability it is important to understand how insurance works and to identify the specific tools it uses to do this.

Insurance governance tools

Risk transfer is at the heart of insurance: the purchaser pays the insurer to take their risk, and, in the event of loss or a trigger, the insurer provides a certain, agreed upon, financial compensation (Rejda & McNamara 2013; Hochrainer et al. 2009). This process is possible because insurance pools risk. Funds from a large number of policy holders pay the losses of the few in a given time period. If the events are independent, unintentional and accidental, there is no correlation between the risks and there are enough participants, the insurance company will be able to predict gains and losses and cover pay-outs (Rejda & McNamara 2013). Being able to cover payouts, even for catastrophic events, means that insurance companies must have capital at hand through premiums, reinsurance, and investments on the financial market (Cook & Dowlatabadi 2011). Most insurance companies are for-profit, which means the premium must be high enough to guarantee a profit (Ben-Shahar & Logue 2012). While non-profit, public and some public-private insurance programs do not generate profits, they still must guarantee sufficient income to cover costs and may need to raise premiums to match risks (Michel-Kerjan 2010;

Thirawat et al. 2016). Regardless of profit, all insurance providers must be able to measure and predict risks and costs to ensure they will be able to cover payouts.

The core requirement of insurance providers to be able to cover payouts raises several challenges for using insurance in the adaptation context. For instance, when insurance providers underprice premiums for at least some policy holders – such as through subsidies – this risk is passed to the rest of the pool or even outside the pool to the larger public (Selmier & Winecoff 2014). Displacing risk to the public could intensify climate vulnerabilities by undermining the financial viability of the public or the state itself if the state picks this risk up (such as by providing subsidies).

Another related complication of using insurance in the adaptation context, is that in order to maintain sufficient liquidity insurance providers may transfer risks to a broader network, usually a global network (Sturm & Oh 2010; Michaels et al. 1997), by using risk transfer tools such as index-linked securities (Michel-Kerjan 2010; Johnson 2014). For example, insurers could not insure much of the economic undertakings in Florida without the ability to transfer at least some of the risk to the global financial market (Medders 2017). Reliance on such tools undermines the capacity for insurance to incentivize behavior change to reduce risk because the risk transfer through the global network reduces the visibility or awareness of actual biophysical impacts.

Finally, insurance systems for adaptation must deal with the potential that the provision of insurance itself might reduce either the immediate actors or the insurance providers' incentives to change behaviors that would reduce their vulnerability to climate impacts. Over time, failing to recognize actual biophysical changes in insurance programs could undermine their long-term sustainability. For instance, indemnity insurance restores the policy holder to the approximate financial position prior to the loss/occurrence (Rejda & McNamara 2013). Consequently, it is possible that policy holders will be indifferent to losses, and thus fail to change behavior, because of the presence of insurance (Rejda & McNamara 2013; Ben-Shahar & Logue 2012). In

contrast, index insurance is not tied to actual losses. Instead it is tied to the crossing of some threshold, typically wind speed, amount of rain or dryness of soil (Hochrainer et al. 2009). Index insurance is supposed to avoid the issue of moral hazard because it is not coupled to any actual risk reduction. However, it is also possible using index insurance creates moral hazard for insurance providers, as they are insulated from the consequences of the policy holder ignoring biophysical risks. Either way, reducing the financial risk of the insurer motivates insurance providers to govern the actions of policy holders (Ben-Shahar & Logue 2012), but this may not address the issue of ignoring biophysical changes.

Overall, insurance providers seek to minimize non-commodifiable risk they cannot easily transfer, and shape remaining risks into measurable, predictable and often profitable forms. This requires them to monitor and shape policy holder choices. As suggested by governance scholars, governance activities authoritatively direct the actions and choices of many actors in an ordered and intentional fashion with goals of a public nature focused on governing societal problems and creating opportunities with a range of organizations and relationships (Huiteima et al. 2016; Chhotray & Stoker 2009; Pierre & Peters 2000). From this perspective insurance can be seen as a form of governance because it has authority over the actions and choices of actors ranging from a single individual to a city to pools of nation-states; in an highly measurable and predictable manner and therefore intentional; with the goals that are desirable for States as well as the general public such as climate change adaptation; with institutions ranging from privately held international organizations to regional non-profits and public-private partnerships of many forms (Ben-Shahar & Logue 2012; Rohland 2011; Grove 2012; Ewald 1991; Paudel 2012).

As identified in Lueck (in review), the insurance industry uses six specific tools to direct the actions of policy holders which could support or impede adaptation on the ground. These tools are: increase premiums, refusal to insure, risk reduction, information/data gathering, pressuring governments to enforce regulations or take measures, and, requiring a link between insurance and biophysical risks. Each of these tools enables insurance to guarantee measurability,

predictability, liquidity and when relevant profitability, and simultaneously monitor and shape the actions of policy holders.

These tools shape action in many ways. Insurance can provide incentives for policy holders to reduce risk by taking adaptive measures or by insisting on certain building features to qualify for coverage (Botzen 2013; Ward et al. 2008). The insurance industry can also pressure governments to implement policies designed to incentive or force change in the actions of other actors, such as through building codes and zoning (Botzen 2013). Finally, insurance companies can, and do, increase premiums to match the risk (Botzen 2013), including by linking what is insured to biophysical circumstances (Michel-Kerjan 2010).

However, the expansion of governance to non-state actors may not be without risks of its own. As O'Brien et al. (2009:3/16) state, "Corporations and private businesses have gradually acquired the functions of governments in the provision and care for public goods, yet without having any formal responsibilities to citizens." When corporations govern, they must consider their shareholders and citizens have no direct authority over them. Moreover, private companies are not beholden to any principles of justice and may be protected from public pressure to uphold these.

Considering that international calls for insurance for adaptation stem, in part, from a desire to support climate change adaptation for the poorest and most climate vulnerable (Linnerooth-Bayer & Hochrainer-Stigler 2015; Schäfer et al. 2016; InsuResilience 2017), asking about the potential justice implications of using insurance to govern adaptation is timely. This is particularly true when combined with earlier questions about the extent to which financial protection might support or impede adaptations to a changing climate. To what extent are current efforts to use insurance as a form of adaptation reducing the vulnerability of policy holders, and what to date, have the justice implications of these efforts been?

4.3 Methods

Using a set of seven agricultural adaptation insurance cases we first identify which governance tools are being used to understand how insurance programs are attempting to change policy holder's behavior and how well this resonates with adaptation needs in a changing climate. Within this assessment we also ask how these tools are being used in terms of identifying what the individual, group or society is adapting to, who must adapt, when, where and why (Meerow & Newell 2016; Eriksen et al. 2011).

We then examine each of the cases in more depth to identify the justice implications of each particular program. To do this we use a multivalent approach to justice which includes distributional, procedural and recognition justice (Klinsky 2015; Klinsky & Winkler 2018). Distributional justice is where (re)distribution of wealth and goods fulfills social justice and draws attention to who benefits in which ways. Procedural justice addresses the means of achieving the outcome of social justice, and focuses on how trade-off decisions are made, while recognition justice examines how and if individuals and groups are valued, included, symbolized and portrayed (Fraser 2009) within these processes.

In order to systematically identify how each of the three elements of our approach to justice was dealt with in each case, we created a set of indicators tied to each form of justice. Indicators of distributive justice included compensation and credit access as these are central determinants of financial outcomes. Procedural justice indicators included information provision to program participants and engagement of policy holders and intended policy holders. Recognition justice was assessed through explicit identification of marginalized individuals, such as single women, and of groups as entities (in recognition of the fact that many agricultural communities may include both individually focused and group focused aspects).

Case Selection

This exploratory study used a two-pronged search approach which resulted in the selection of seven cases of climate change insurance for crop-based agriculture. This selection process started with a google scholar search using the search terms: 'insurance as adaptation,' 'insurance for adaptation,' and, because most of these programs are a form of index insurance for climate smart agriculture, 'adaptation index insurance climate-smart agriculture.' We then selected cases for which adequate documentation existed to assess three things essential for our research question: which insurance governance tools were being used; what forms and for whose benefit adaptation actions were being pursued; and what the potential justice implications of these patterns might be.

While other insurance programs exist, using the documentation filter yielded seven cases (those in India, the Horn of Africa-including Ethiopia [R4], Malawi, Agriculture and Climate Risk Enterprise [ACRE], Nigeria, West Africa and Austria) with sufficient documentation to allow an adequate assessment.

This research included five cases with actual on the ground operationalization and did not include regional or national level programs that did not specify individual recipients. As such, we excluded case studies focused on international-scale catastrophe bonds, weather derivatives, or insurance for resilience sovereign pooling such as the Caribbean Catastrophe Risk Insurance Facility]. Johnson (2013a; 2013b; 2014) and Grove (2012) have excellent discussions about these other forms of adaption insurance.

We expect that as insurance for adaptation becomes more established more cases will emerge, allowing for more complex and in-depth empirical investigations. Even with these criteria, many of the cases were not sufficiently well documented to enable full evaluation: most lack sufficient documentation to fully assess who was adapting to what, when, where and why. These data

limitations point to the urgent need for further empirical work into this form of adaptation governance. The key elements of each case are listed in table 3 in appendix D.

4.4 Results

Our findings focused on two main elements: identifying how insurance was being used to try to change behavior, and then identifying the justice implications of these efforts.

How Insurance Programs Are Trying to Change Behavior

Our first level of assessment focused on the specific governance tools being used in each case to change behavior. Table 4 presents an assessment of the extent to which these tools were used in each case, as well as whose risk was being reduced, specifying between financial risk reductions for international financial institutions and local financial institutions, and between risk reduction of farmers for turning to extreme coping measures (i.e. migration) and risk reduction for the agricultural crop.

Insurance tools	Cases						
	India	West Africa	R4	ACRE	Nigeria	Malawi	Austria
risk reduction							
• For farmers (extreme coping measures)	yes	yes	yes	yes	yes	maybe	yes
• For farmers (agriculture)	no	no	yes	no	maybe	no	maybe
• For local financial institutions	yes	yes	yes	yes	yes	yes	yes
• For international financial institutions	N/A	yes	yes	yes	maybe	yes	no
increase in premiums	maybe	yes	maybe	maybe	N/A	yes	maybe
refusal to insure	yes	yes	yes	yes	yes	yes	yes
information/data gathering	yes	yes	yes	maybe	yes	yes	yes
pressuring governments to enforce regulations or take measures	no	no	no	no	no	no	maybe
coupling between insurance & biophysical	no	no	yes	no	no	no	yes

Table 4: Insurance as governance structural assessment. The first column contains the tools and the questions who and for what. The assessment uses: yes, if the tool is clearly used; no, if the tool is not used; and maybe if the tool could be implied but is not clear.

Overall, we found that while all six governance tools could be used to enable or compel adaptation to the changing biophysical climate, the primary forms of adaptation enabled in these cases are to the financial system itself. This observation is based on two dominant patterns: not all governance tools were being used, and when used their capacity to link behavioral change to biophysical changes was less prominent than efforts to tie behavioral change to the financial system.

First, it was striking that of all the tools, the two most explicitly in line with directing behavioral changes that would enable adaptation to biophysical shifts were the two most rarely used. Specifically, pressuring the government to regulate or take measures and coupling insurance to the biophysical situation (climate change) were nearly absent. Only the R4 and Austrian case studies included a direct coupling between the insurance provided and maintaining a sustainable biophysical situation for agriculture (Adegoke et al. 2017; Hochrainer-Stigler & Hanger-Kopp 2017), and the Austria case is hypothetical. Interestingly, both of these insurance tools could compel or enable enormous gains in adaptation to the climate. Governments can and do require actions that are less risky or lower vulnerability (Thomas & Leichenko 2011), and insurance providers do couple insurance to actual biophysical circumstances (Ward et al. 2008; Botzen 2013), but these aspects, outside of R4, were not applied in the agricultural adaptation cases examined.

The more commonly used tools (premiums, refusal to insure, risk reduction and information gathering), all *could* be purposefully coupled to biophysical changes, but they do not need to be in order to work from the perspective of an insurance provider. Biophysical coupling appeared to be missing in these cases. For example, scheduled premium increases could be used to signal long-term anticipated changes to biophysical risks and to incentivize pre-emptive adaptive action (Suarez & Linnerooth-Bayer 2010). However, premium increases were explicitly included in only two of the programs and hinted at in the rest. Moreover, because these cases all use index

insurance, moral hazard will not stimulate providers to increase or decrease premiums based on reduced crop risk, and definitely not on reduced vulnerability. Instead, the premiums are connected to the costs and profits of the insurance provider.

Refusal to insure was present in all cases. However, none of the cases linked refusal to insure with risky behavior or choices. In fact, the inverse was sometimes true: risky behaviors and choices in the form of higher yield, higher risk crops were a reason to insure, which fits with historical uses of insurance but does not necessarily facilitate adaptation to the climate. This was especially visible in the Malawi and West Africa cases where the insurance products were designed to support higher yield cash crops which are more vulnerable to the changing climate (Hochrainer et al. 2009; Osgood et al. 2008). Presumably unintentionally, this form of insurance creates an incentive for the farmer to become dependent on crops which are not sustainable due to the changing climate.

Information/data gathering was present in every case. However, with exception of the R4 case, it was not linked to adaptation to the climate by the farmers. Suarez and Linnerooth-Bayer and Hochrainer-Stigler and Hanger-Kopp recommended the use of weather data to influence what crops farmers would plant but both were merely recommendations – one that was not followed (Malawi) and one that was hypothetical (Austria) (2010; 2017).

In contrast with the limited attention given to reducing biophysical risks, all cases featured mechanisms to reduce financial risk. All seven cases reduced the risk, and in some cases removed it, for local financial institutions. The West Africa case went so far as to state “By protecting the portfolio of the banks and MFI’s, insurance secures the access to credit and supports the development of the agricultural sector” (Adegoke et al. 2017:15).

In addition to subsidizing premiums in some cases (India, ACRE – first premium only), all the programs except for the Austrian case reduced the risk of local financial institutions by linking

insurance to loans. In two cases (Malawi, West Africa) farmers could take out loans for agricultural inputs only if they had insurance, and, the focus was for high yield seed which was not tied to climate change but to cash crops (Malawi) and to higher risk inputs such as fertilizer and larger planted surface (West Africa) (Adegoke et al. 2017; Hochrainer et al. 2009; Osgood et al. 2008). In India, the farmer had to have insurance if the farmer had a loan and there was no adaptation to the climate necessary (Adegoke et al. 2017) and in the R4, ACRE and Nigeria cases loans were available once the farmer had insurance with the idea that farmers would be able to buy fertilizer or other high cost inputs, although once again these inputs did not have to be tied to the changing climate, even in the R4 case (Adegoke et al. 2017; Peterson 2012). Basically, the insurance was a form of risk reduction for the lending financial institution, a form of guaranteed no-default (Adegoke et al. 2017; Meze-Hausken et al. 2009; Swain 2014).

Furthermore, most of the cases appeared to reduce financial risk for the international insurance companies (Adegoke et al. 2017; Peterson 2012; Hochrainer et al. 2009; Osgood et al. 2008). Johnson, however, states that international reinsurance companies are taking a loss in many of these programs (2013b) which on the surface appears to contradict the case studies. But because the long-term goal of these companies is to access these low-to-no density insurance areas (Johnson 2013b), this strategy would still lower the financial risk over the long-term for these for-profit companies.

Finally, the programs also reduce the risks of extreme coping mechanisms (ie migration and off-loading of assets) for farmers. In the event of a disaster covered by the insurance, the farmers would receive a pay-out instead of selling assets (Adegoke et al. 2017; Suarez & Linnerooth-Bayer 2010; Hochrainer-Stigler & Hanger-Kopp 2017; Meze-Hausken et al. 2009).

In contrast to efforts to reduce financial risk, there was little risk reduction for agricultural products themselves. In the case in Malawi the insurance was for groundnuts which are higher risk (more climate sensitive) but form a lucrative cash-crop (Hochrainer et al. 2009). In fact, the loans are

intended to increase the willingness of farmers to buy higher risk seeds for a higher yield crop (Hochrainer et al. 2009; Osgood et al. 2008) or buy agricultural inputs which may temporarily increase output (Peterson 2012; Adegoke et al. 2017) but can also have serious consequences for sustainable land use (R4). The India case study stated this most directly, “At present, crop Insurance programmes have no link with the adoption of any climate smart agriculture practices and technologies” (Adegoke et al. 2017:10).

This research suggests that the financial situation appears to be the primary situation to which the farmers are adapting, not to the changing climate. Loans connect farmers to the global financial system which they were otherwise unable to access. Insurance through its structure, likewise, connects farmers to the global financial market. Both the loans and the insurance enable farmers to reduce their coping measures in years of extreme events. Premiums were connected to costs and profits of the insurance provider and none of the cases linked information/data gathering and refusal to insure with any type of risky choice or action.

It is not clear that this increased financial reach is enabling adaptation to anything other than the global financial market. This adaptation is logical; these tools are focused on the financial system. However, without a specific coupling to the changing climate one of the goals of insurance for adaptation – enabling the poor and most climate vulnerable to adapt to the climate – cannot be fulfilled and these same adaptation issues raise distributive justice trade-offs over time.

Justice Implications of Insurance Design

Through our multi-valent approach to justice analysis, we attempted to identify the distinct distributive, procedural and recognition-based implications of these programs. We discuss each below.

Distributive Justice: Despite calls for insurance to protect those who are most vulnerable, this research identified consistent tensions between providing short- and long-term benefits to farmers, and between the direct and indirect implications of risk transfer embedded in these programs.

First, guaranteeing compensation or providing credit for those who are or will suffer from the consequences of the current socio-economic system could promote distributive justice.

Improving farmers socio-economic situation should increase generic | adaptive capacities which, if the underlying assumption of a connection between generic capacities and climate change adaptation is correct, should enable some climate adaptation.

Unfortunately, in this study compensation and credit access appear to be completely decoupled from climate change which poses long-term risks to the distributive benefits these programs might otherwise provide. This is most glaring in the case of India where there is no connection between the program and behavioral change (Adegoke et al. 2017), and in the case of ACRE which ignores biophysical threats by replacing the seeds which failed in the first place (Adegoke et al. 2017).

If there is no connection between the insurance and behavior adaptation to biophysical shifts, the distributive gains from compensation and credit cannot be sustainable over time. Once the subsidies or the profit is gone, what happens to the farmers who have adjusted their crops and their farming methods to the global financial market? What if those adjustments to the global financial market actually exacerbate the climate change challenges which would fit with risk (Sarewitz et al. 2003), disaster and hazards (White et al. 2001) and resilience (Anderies et al. 2006; Salt & Walker 2012) literature? Panda et al. discuss how access to credit enabled farmers in the India state of Odisha to avoid adaptation to the changing climate (2013). Increasing short-term financial capacities does not necessarily increase adaptive capacity of the individual if it inhibits farmers from being responsive to the changing climate over the long-term.

Second, risk transfer to the state, or other actor, is also an important element of long-term distributive justice. Separating insurance from biophysical risk means farmers will at some point either have to quit farming due to the changed climate (Suarez & Linnerooth-Bayer 2010) or the subsidies will have to continue indefinitely. However, subsidizing premiums for farmers, local insurance and financial institutions transfers risk from these actors to the body that is subsidizing or guaranteeing the premiums. If governments are carrying risk instead of insurance companies, this could transfer risk to the public. Moreover, these forms of subsidization protect the exact organizations (e.g. local, regional and international insurance and reinsurance companies) from carrying the risk that they are supposed to be taking over and transferring to the international financial market.

From this perspective, the short-term distributive benefits of compensation and credit do not address long-term climate adaptation challenges. Instead, they could be a form of risk displacement to those who are carrying the subsidized risk of the local financial institutions and farmers – largely governments – which could undermine the potential distributive benefits of the program.

Procedural and Recognition Justice: It has long been acknowledged that participation of those most affected is a crucial element of adaptation (Few et al. 2006). As a basis of both procedural and distributive justice, adequate recognition of actors entails paying explicit attention to their specific needs, possibilities, existences and realities. Two findings emerged from this attempted analysis: first, despite some acknowledgement of procedural justice it remains a relatively weak element of these programs, and second, analyzing how existing insurance programs either recognized those being insured, or sought to include them was difficult due to systemic data limitations.

We operationalized procedural justice by looking at information provision and participation. Only three of the programs explicitly included information provision to farmers: India on how to get insurance; R4 on the entire process from inception to evaluation; and Malawi on how to get insurance and how to get pay-outs. Although this initially raises procedural justice concerns for the programs that do not have this information, especially ACRE where it is not clear that the farmers who send the SMS are even aware of the consequences (Adegoke et al. 2017), several of the programs, including Malawi, list the farmer's understanding of the programs as an ongoing challenge (Adegoke et al. 2017). This implies that farmers apparently do not understand or do not have the information how the program works and what they will or will not receive in the event of a trigger.

Most of the programs did include some attempt at participation in decision-making (Adegoke et al. 2017; Suarez & Linnerooth-Bayer 2010). However, participation ranges from absolutely nothing (ACRE), to a farmers' satisfaction index (India), to directly including local communities in the entire program process (R4) with the primary issues being how and who decided what risk was to be covered and who decides who gets what information. The R4 program developed the programs with communities, using local knowledge for premium rates, pay-out triggers, and even what gets insured when (Adegoke et al. 2017).

All the cases discussed the need to inform farmers what the insurance product covered, even if this was not happening (Adegoke et al. 2017). Much of this information was intended to convince farmers that insurance was a good idea, the organizations were trustworthy, and the program would improve their lives (Adegoke et al. 2017; Meze-Hausken et al. 2009; Hochrainer et al. 2009). This is not information provision for procedural justice but a form of advertising. There was one exception to this marketing necessity. The R4 program had more demand than could be accommodated (Adegoke et al. 2017). Interestingly, the R4 case was also the only program with extensive information provision with limited advertising and extensive participation.

From a recognition justice perspective, we were primarily interested in discovering which kinds of actors were 'seen', in particular the extent to which only individuals were included or the potential collective nature of some communities. This element could not be fully analyzed due to information gaps. The R4 program specifically recognizes both individuals and collectives for the general program, individuals for credit and compensation, and, implicitly, collectives in some form of compensation (Adegoke et al. 2017). Interestingly, the R4 program appeared to be the only program with more demand than they could fill (Adegoke et al. 2017). In addition, both India and R4 clearly included farmers and segments of society that normally are left out, even in programs addressing the poor and marginalized. India stated that the insurance program recognized sharecroppers and tenant cultivators and R4 clearly recognized single women, those who had to trade work for insurance and communal entities (Adegoke et al. 2017).

These efforts, in light of both procedural and recognition justice, suggested that program designers are aware of the specific needs and requirements of those they insure and are attempting to more fully include them, but the lack of documentation of these efforts is concerning. As a community of scholars and analysts interested in the ways in which insurance is being designed and implemented, ensuring that empirical evidence is gathered about these elements of justice - particularly due to the importance of local engagement in adaptation – is essential. As work on insurance deepens, we expect that these elements may be more fully explored.

4.5 Conclusion

Increased attention has been devoted to exploring insurance as an enabler of, or form of, adaptation to climate change. The logic underpinning the calls for insurance in the adaptation context has stressed the potential to reduce the vulnerability of those who are most at climate risk and/or have the least financial resources, largely by increasing their general financial capacity, and, potentially, by shifting actual behaviors to become more adaptive to climate change. We

sought to empirically examine whether or not insurance can, or is, enabling adaptation in either or both of these ways, and what the justice implications might be.

Insurance governance tools as used in the cases we examined provide evidence that insurance providers and other financial institutions involved in the projects do have their financial risk reduced, and, financially stimulating the agricultural sector was an explicit goal in some cases. Although a cash-producing agricultural sector is valuable to any country, it does not automatically reduce vulnerability of the poor and climate vulnerable nor does it automatically enable climate adaptation.

Although insurance may be enabling adaptation to the global financial market generally, improved financial circumstances and protecting against financial risks do not necessarily translate into sustainable adaptation. Improved financial circumstances will not protect against a crop vulnerable to drought or moisture, it will only delay the necessity of coping measures. Likewise, added fertilizer may increase the total crop in the short-term but, if not done in an environmentally responsible manner, may exacerbate vulnerability to climate variations. Even if there is wealth accumulation by the poor and most vulnerable through insurance for adaptation, there is no guarantee nor evidence that vulnerability to climate variation has diminished.

This finding – that insurance may not be enabling adaptation to climate change – is supported by other research. Knudson (2018) and earlier Müller et al. (2017) and Taylor (2016) all directly or indirectly address how insurance has not improved sustainable, long-term use of the land but instead has caused farmers to change to fit the new financial-social situation. Insurance itself will not solve the challenges of increased vulnerability to climate change variations but it will link policy holders to the global financial market (Peterson 2012).

In addition, risk transfer in existing insurance schemes could intensify some distributional justice concerns. Specifically, the goal of using insurance to transfer risk from the poor and most

vulnerable to the wealthier and less vulnerable, is not fulfilled if the risk lodges with the governments of those poor and vulnerable. As discussed by others (Selmier & Winecoff 2014; Sturm & Oh 2010), financial risk can be transferred across private and public spheres, or outside the risk pool entirely to a different network. If the risk lodges with governments it could erode the capacity of these governments to provide public services in other ways, representing a hidden risk transfer to the very people the insurance is in theory protecting.

Additionally, if compensation and access to credit are central to the distributive benefits of insurance and are not linked to the changing climate, they may undermine long-term distributive justice in two ways. First, failing to link them to the changing climate may disincentivize early behavioral change that would have long-term benefits to actors. Second, failing to ensure the financial sustainability of such governance tools threatens the farmers these programs seek to protect in the first place if they become dependent on them. And third, the subsidies could be a form of global risk displacement from the large private risk pools of participating insurance and reinsurance companies to those who are carrying the subsidized risk of the local financial institutions and farmers.

Procedural and recognition justice concerns also exist, particularly around the issues of who decides whose risk is reduced for what and who decides for what. Indeed, the meagre information provision except for marketing and the full range of participation from nothing to extensive imply that much work needs to be done in this area. Moreover, with the exception of the R4 case and India recognition justice was scarce. Interestingly, in the one case where the policy holders were involved in the procedure from start to finish, R4, and where multiple individuals, communities and social forms were explicitly recognized, the insurance for adaptation product did produce adaptation that was directly connected to the climate. In fact, the R4 case displays the potential of insurance for adaptation to fulfill international calls for insurance to be or to drive adaptation to the changing climate for the poor and most climate vulnerable which only emphasizes the issues in most of the other cases.

However, to achieve this insurance for adaptation that serves the stated goals of international calls for insurance for adaptation, more research needs to be done on: the relationship between increased assets and actual adaptation to the changing climate; the role of each of the insurance governance tools; and, the ensuing consequence for climate just adaptation.

CHAPTER 5

IS INSURANCE STILL A POTENTIAL ADAPTATION SOLUTION?

In the conclusions of all three chapters I state that insurance still is a particularly useful instrument to govern, be, drive, and enable climate adaptation despite the documented shortcomings and justice concerns. However, I do not interrogate what other alternative research is necessary to achieve more just and equitable insurance in the climate adaptation space, which key findings must be considered in solutions and what these potential solutions could look like. This chapter begins to fill in these lacunae.

Alternative research to interrogate insurance within climate adaptation

Chapter 2 examined the entire 'insurance industry climate adaptation system' including the approaches that a systems lens illuminates. Insurance influences policy holder choices through two different feedback loops, one balancing and one reinforcing. This influence that insurance has on its policy holders and the difference between the feedback loops both provide insight into how insurance could (should) be further interrogated in the adaptation space. One of these is insurance as governance which I then expanded on in chapter 3. However, there are several others.

Social and political theories on power would provide salient insight into the role insurance is playing within adaptation. On the international level both problem framing theory and game theory would provide insight into reinsurance's interactions with the G7, within the UNFCCC, and within the international adaptation community. Within sociology there are many rich theories on power (Clegg & Haugaard, 2009; Haugaard, 2002) which could interrogate the influence which insurance maintains over policy holders. Similarly, decolonialization from multiple disciplines examines power relations. In this instance, decolonization may be particularly useful since most insurance companies involved in adaptation pilots and programs are from Western countries while most of the pilots and programs are in former colonies.

Social contract theory and theories of democracy and legitimacy also interrogate power but then from the perspective of governance. O'Brien et al. (2009) discuss issues of using private companies to carry out public goals. Likewise, democracy and legitimacy theories both raise issues as to the appropriateness of using private insurance to govern adaptation. Using these disciplines to examine insurance in the adaptation context would help guide decision-makers choices on what insurance approach to use for adaptation in their own local context and emphasize issues which fell outside the scope of this dissertation.

Furthermore, theories which address stranded asset/waste clean-up are imperative in the insurance for adaptation context. Buildings will be abandoned. The only question is who will be responsible for the clean-up: the insurance companies which made building in a risky location possible; the individuals who invested in the location; the local government who is stuck with the abandoned property; developers who gained financially? Who should be responsible and who carries the burden of clean-up are pressing issues which require both theoretical, policy and empirical research.

System aspects for developing more just and equitable climate insurance adaptation products

The CAS lens also revealed several other system aspects that could provide policy levers for developing more just and equitable climate insurance products for climate adaptation. Because of the tight and extensive interconnections and interdependencies within global insurance, using insurance for adaptation created a telecoupling of climate events and insurance premiums. Policy holders in high risk, high value locations impacted premiums globally and could even alter the definition of “objective” risk within insurance. Johnson has discussed this impact that a high risk, high value location normally will have on global insurance (Johnson, 2015) but not in feedback loop terms. Likewise, redefining risk has been discussed (Rohland, 2011a; Rohland, 2012) but not in terms of what risk is flowing between participants in a system. Based on the tight

interconnections policy and decision makers should be looking at who is defining “objective” risk within a program, and examine what connections there are to high risk, high value locations. Both can uncover risk transfers that the policy and decision makers may not want and also provide an opportunity for the same policy and decision makers. If they are aware, policy and decision makers can influence the definition of risk and add regulatory walls between the high risk, high value driven volatility and local insurance adaptation programs.

Building redundancy into the system through the inclusion of other forms of risk management or building modularity through insuring risk management instead of property, ranging from homes to crops, could both modify the impact of telecoupling of high risk, high value locations on the global poor and climate vulnerable using insurance.

Redundancy describes the same function being performed by two separate actors, essentially a back-up (Walker & Salt, 2012; Elmqvist et al., 2003). Although redundancy is often considered negative as a loss of efficiency, in complex adaptive systems it enables a system to respond to shocks and disasters such as hurricanes, extreme flooding, excessive heat, even when part of the system is disabled (Walker & Salt, 2012). If policy and decision makers would consciously build in other risk management forms this type of redundancy could easily be achieved. There are many forms of informal risk management. Agrawal (2008) reviews the general forms such as storage pooling where members of a family, community or group store their seeds or harvest communally, diversification of livelihoods, and communal pooling. However, these are not the only approaches. Indigenous peoples have been stewarding the land for millennia and take specific approaches (Barrera-Bassols & Zinck 2003; Derbile, 2013; Mutasa, 2015) which I have not researched. Any of these could be used in parallel with insurance which would build redundancy into the system.

Not only would the parallel use of insurance and other risk management forms build redundancy, it would also build in modularity if the risk management forms are disconnected from the

international financial market. Modularity is about how actors and other elements in a system are linked. Elements that are grouped together with multiple and close links but are only loosely linked to other groups or the rest of the system are modular (Sanchez & Mahoney, 1996; Tyson, 2018; Walker & Salt, 2012). Removing or disabling one group will not cause the rest of the system to fail (Sanchez & Mahoney, 1996). Local risk management such as storage pools, communal pooling and indigenous risk management are not connected to the international financial market. This would build in a break between the tight coupling of insurance and local adaptation in the form of risk management.

This modularity would also provide a means of protecting existing diversity which could be enhanced through the above-mentioned redundancy. Diversity can be characterized in multiple manners. Diversity across types is different types of risk management when addressing risk, for example insurance, maintaining a large bank account for a homeowner or a communal storage seed bank for a farmer family. There is also diversity of composition which in this article refers to what types of risk management and other social systems a community includes in its approach to dealing with risks (Page, 2011). This diversity of composition in resilience is called response diversity, whether a system can respond in multiple diverse manners (Elmqvist et al., 2003).

Insurance fully lacks response diversity. The only form of risk management in insurance is more of the same or connecting to itself, both of which are occurring in the climate adaptation space. Building in modularity by insuring other forms of risk management would increase response diversity and, over the long-term, may increase redundancy through type diversity within insurance itself. Equally important, insurance requires very specific information for calculating actuarial risk and catastrophic models (Johnson, 2013a; Rejda & McNamara, 2013). This information appears to be crowding out other information which is also relevant for local communities and could contribute to more effective local risk management.

Both the balancing and the reinforcing feedback loops could be altered to produce more climate adaptation if insurance would choose or be forced to reduce risk exposure. Currently, insurance focuses primarily on increasing adaptive capacity (freeing wealth for other pursuits than risk management) and sensitivity reduction. Within climate adaptation, exposure reduction is key to sustainable, equitable adaptation but is generally ignored. This could be rectified through insurance rules or through governmental rules regulating insurance.

Both options also illuminate the last issue in this dissertation which a CAS lens brings forth: risk transfer or risk displacement. The tight interconnections within the global insurance industry with an impressive lack of modularity enables the risk transfer that current insurance relies upon. Without this massive spread with quick access to liquidity insurance would not be able to cover pay-outs in a large event, or in the case of climate change, multiple large correlated events.

However, this same interconnectedness creates vulnerability to the international financial market (Johnson, 2013b; Müller et al., 2017; Peterson, 2012), vulnerability to events in high risk, high value insured locations (Johnson, 2015; Rohland, 2011b; Rohland, 2012; Taylor, 2020) and essentially forces those outside of the high risk, high value locations to subsidize those risks (Sturm & Oh, 2010) including the public (Selmier & Winecoff, 2014). Large climate events such as a hurricane on high risk, high value properties increase premiums for all, globally (Johnson, 2015). In fact, this is risk displacement. In insurance risk displacement is normally reduced through rules which limit moral hazard and through information which limits adverse selection. Both are lacking in parametric insurance where the insurance provider has no incentive to limit either. Moreover, in indemnity insurance for high risk, high value locations adverse selection appears to be one of the criteria for choosing to insure and, in certain cases choose to insure through an insurance-linked security (Taylor, 2020). In addition, limiting moral hazard has been focused on reducing sensitivity in a manner which passes risk on to others both financially and through the built environment (Taylor, 2020).

The tight interconnections and interdependencies within insurance, the lack of diversity within insurance and the displacement of risk all raise questions as to whether insurance can function as a form of climate adaptation, a driver of adaptation or an enabler of climate adaptation. Interestingly, this influence that insurance clearly has over its policy holders does open up possibilities which I will expand upon in the last section of this chapter. First, however, two other implications of my findings must be discussed: (in)justice in infrastructure and land use choices and risk transfer/risk displacement.

Two key considerations before developing insurance climate adaptation products

Ensuing climate adaptation (in)justice in infrastructure and land use choices

The built environment and land use are pivotal in this entire discussion, although I do not have a chapter dedicated to the built environment or land use. There are three key areas: how agricultural land is used; who gets to use the agricultural land; and, who gets what type of built environment adaptation and when.

As discussed in the second chapter there are those who support and those who question the use of insurance in the adaptation context. The advocates laud and encourage land use that provides cash crops and increases yield in the short-term, surely valuable in many economies. However, as the skeptics point out, this strategy is often not environmentally sustainable and leads to vulnerabilities to the volatility of the international financial market. Although insurance could tie crop choice to the climatic changes (Suarez & Linnerooth-Bayer, 2010), so far it has not. Only program rules that reinstated the balancing feedback loop in one program studied did so (Adegoke et al., 2017). In fact, the opposite has been the case in India (Adegoke et al., 2017; Sheth, 2017) and several programs in Africa (Adegoke et al., 2017). Furthermore, a case study in the Caribbean found the same issue where bananas were not a good choice for high hurricane risk areas but were supported through insurance for their cash crop value (Knudson, 2016).

In most of the agricultural case studies and in another case study in Mongolia, who gets to use the land also appears to be determined by insurance. Loans and insurance were linked in several of the cases, tying extra financial risk to insurance that was not coupled in any manner to climate change. None of the agricultural cases required the loan to cover anything directly related to responding to climate change. In Mongolia, the situation was more extreme. Those who already had specific access rights or traditions, were able to command the use of the best grazing and wintering grounds. Those who did not, sank deeper into poverty and became more vulnerable to climatic shocks (Taylor, 2016).

This process is not limited to pastoral herders or sharecropping agriculture. Who uses what land is a key element in high risk but desirable locations that alters who carries what risk. High value, high risk locations which have access to private insurance or choose to go through insurance-linked securities must abide by multiple sensitivity reduction measures. These measures alter the built environment. In fact, there are multiple studies where sea walls (Jackson et al., 2012; Romine & Fletcher, 2012), rock training walls (Brayshaw & Lemckert, 2012) and beach replenishment (Coburn, 2012) protect high value, high risk properties. Simultaneously, in the best-case scenario middle-income, poor and marginalized receive nothing (Coburn, 2012) despite the social value of their home. More commonly, the person who is next to a sea wall but cannot finance one will lose their beach (Jackson et al., 2012; Romine & Fletcher, 2012). The person(s) who is next to a dam or other sand/sediment flow altering hard infrastructure will also suffer changed environmental circumstances (Brayshaw & Lemckert, 2012). However, perhaps one of the most extreme issues is that when these high risk, high value buildings go bust, which with climate change they will, the local government and population that already was probably negatively impacted will have to pay for the removal, renovation or otherwise of these sensitivity reductions (Taylor, 2020).

Interestingly, many advocates of insurance and programs supported by or developed by CGIAR all desire a coupling between responsible, sustainable land use and insurance (i.e. Adegoke et

al., 2017). That the on-the-ground programs generally do not provide this, at least partially, stems from which tools insurance is using to govern (Lueck, in review). However, there are existing insurance programs which are tightly coupled to land use and the built environment. Sweden has a program where the insurance company can hold a local government liable if they allow building in flood plains (Crichton, 2008). This is a structural law which is one of the manners mentioned earlier to alter how insurance governs. Similarly, Hochrainer-Stigler and Hanger-Kopp (2017) argue that Austria should add this kind of coupling between land use (agricultural products in this case) and insurance, and United Kingdom was forced to enforce its own land use regulations by private insurance companies (Huber, 2004).

The built environment and land use demonstrate what consequences insurance could, can, does and maybe should have for adaptation. However, one key aspect of insurance, that insurance transfers risks away from policy holders, may undermine insurance programs as well.

Risk transfer - risk displacement

We know that urban development can and does create vulnerabilities through the built environment (i.e. Clement & Kanai, 2015; Marks, 2015). We also know that despite attempts to limit this vulnerability, urban infrastructure choices often exacerbate it (Montz et al., 2017; White et al., 2001). What often is not mentioned is that if the building or infrastructure project is not insured, it normally will not happen.

All three articles broach the subject of risk displacement, especially the displacement of financial risk from insurance and the international financial market onto subsidizing bodies, individual policy holders and the public. Furthermore, through built environment choices as mentioned in the previous section, risk may also be displaced from those who should be carrying the risk to the public or future generations. Both are important contributions because insurance is supposed to be reducing exactly this risk. Although there remains much to be discovered in this area, there is

enough information in the literature to discuss the main risk displacement mechanism, the reinforcing feedback loop for ILS products.

The whole point of insurance is to transfer financial risk. Indemnity insurance must develop rules and information to limit moral hazard and adverse selection, at least theoretically and in the books (Rejda & McNamara, 2013). Both moral hazard and adverse selection transfer risk in an undesirable manner to the risk pool, this is called risk displacement. Reducing moral hazard in indemnity insurance is particularly important. Policy holders who raise the risk in the risk pool by undertaking activities because of the presence of insurance transfer too much risk to the risk pool, creating risk displacement. Similarly, insurance providers have a term for the process where policy holders with high risk purposefully seek out insurance. It is called adverse selection which also can create risk displacement. Risk displacement threatens the measurability, predictability and non-correlation that indemnity insurance requires.

Parametric/index insurance can ignore moral hazard and adverse selection because the trigger and therefore pay-out are disconnected from any choice or action of the policy holder. What is omitted from both indemnity and parametric insurance is that there are other forms of risk transfer that a community, region, State, society may consider undesirable and therefore risk displacement. Furthermore, when private risk, whether in insurance or investments, is transferred outside the risk pool it too is risk displacement. Risk can and is regularly transferred outside a network to a larger or connected network (Sturm & Oh, 2010). Likewise, risk that is supposed to remain within a private risk pool is regularly transferred to the public (Selmier & Winecoff, 2014). Both are happening in climate adaptation. A particularly extreme example of this displacement occurs in the ILS context.

When insurance focuses on high value properties in high risk locations it appears to be purposively partaking in adverse selection. As discussed above, insurance can be viewed as a form of finance and the ILS products are, literally, financial investments. When transferring this

private risk outside the original risk pool, the risk transfer could become a risk displacement at the point that the risk is transferred to the public or built environment in proximity to the high risk high value locations. These high value, high risk property concentrations producing ILS products which are then transferred to the international financial market appear to be the kind of risk transfer that is risk displacement as discussed in Selmier & Winecoff (2014). Essentially, the local adaptation of certain individuals concentrated in a high-risk location, which without ILS products or a reinforcing feedback loop, would be their responsibility, have their financial burden transferred away from them. The responsibility is transferred to their insurance providers which Taylor (2020) argues is also risk displacement, although without using that term. The burden of dealing with the left-over built environment after an event or after the location is no longer lucrative is transferred to the public (Taylor, 2020). Furthermore, these ILS products also increase the volatility of the international financial market (Johnson, 2015; Taylor, 2020). This volatility creates exactly the vulnerability that the skeptics of insurance in the adaptation context are concerned about.

The ILS firms in Florida are not a unique occurrence of this. Already in 1906, reinsurance chose to remain active in San Francisco despite the known risks of earthquake and fire because it was a lucrative market (Rohland, 2011b; Rohland, 2012). To maintain their spread reinsurance companies simply began to add more lines of reinsurance, redefined risk for earthquakes and actively acquired more policy holders (Rohland, 2011b; Rohland, 2012). Restated, they simply guaranteed that they could transfer their risk to a larger pool of participants in a manner that continued to provide profits and limited their own risk while increasing their need for liquidity. Cross-scale relationships, telecoupling and insurance's capacity to influence all result in risk transfer which is the whole purpose of the entire insurance industry. However, this view is from that of the industry. Not only is risk transferred from local policy holders to primary insurers and reinsurance but risk is also being transferred within the risk-pool, outside of the risk pool to the public, through the international financial market to the planet and through the built environment

locally to both policy holders and those who must deal with increased risk due to the built environment or deal with future uninsurable risk.

How to use insurance in a just and equitable manner

As mentioned above, insurance is not the only form of risk management. It may not even be a particularly good form of risk management in the case of climate adaptation. However, because of its influence it may be the only form of risk management that can be implemented at a global scale for local adaptation. Therefore, it is important to consider how it could be implemented in a more just and equitable manner than is currently the case. This section is based on the discussion above about modularity, diversity and redundancy.

Modularity and diversity can be built into a system (Sanchez & Mahoney, 1996; Tyson, 2018). Many mitigation and adaptation projects are beginning to consider working with nature. Working with nature provides another avenue of risk management. If insurance is used to insure residential property in high risk locations through floating houses and other nature based sensitivity reductions that are not insured at this time and do not increase vulnerability of others – both human and non-human – now, in the future or 'behind' the dike/dam/levee then insurance may be able to alter the reinforcing feedback loop enough that there is less or potentially no risk displacement to the global society.

Similarly, many social systems already have extensive risk management forms. In the Sundsvall case there was a fire brigade (Rohland, 2011a) and most local, traditional and indigenous communities, such as in the agricultural cases, have some form or many forms of risk management (i.e. Agrawal, 2008; Barrera-Bassols & Zinck 2003; Derbile, 2013; Mutasa, 2015). Because parametric/index insurance is becoming the norm in the climate adaptation space and it is not connected to specific property (Johnson, 2013a), insurance could be used to insure other forms of risk management. This could be based on asset framing which looks at the strengths of the person or community (Shorters, 2020). A particularly interesting example is the ice towers in

Nepal which are built during the winter and then used to deliver water during the dry months of the summer (Kumar-Rao & Jazbec, 2020). Seed banking is another communal risk management form that would not need extensive creative alterations for insurance to insure. In addition to building in modularity and diversity, both options would also support local distributive and recognition justice.

One other option is building other forms of risk management where insurance has become the primary form of risk management. Insurance will not remain indefinitely in high risk locations, despite the growing romance with ILS. Insurance will leave or crash (Johnson, 2015; Taylor, 2020). See all the news articles on insurance pulling out of certain locations in California (i.e. Lustgarten, 2020; Penney, 2020). We know in coastal and riverine areas poverty, place identity and sunk costs keep people from relocating (Ionesco et al., 2016). Instead of using insurance for these locations, maybe it is time to step beyond the limitations of our current economic understanding of human welfare and turn to other approaches such as capabilities (Nussbaum, 2003; Sen, 2004), limits on the types of power people may exercise (Walzer, 2008), and SDG's (Kanie & Biermann, 2017) and develop other forms of risk management based on relationships, capabilities and human rights.

Conclusion

Each of the sections in this chapter form a necessary piece for formulating, discovering and developing just and equitable applications of insurance in the climate adaptation context. Wicked problems cannot be 'solved' with one lens or discipline and climate adaptation is a wicked problem without clear solutions encompassing complex interconnections and interrelationships. The alternative research approaches suggested at the beginning of this chapter all would contribute to developing more just and equitable insurance climate adaptation products. Similarly, but focused on systems thinking and governance, redundancy, modularity and diversity all would contribute to insurance achieving its purported goal of supporting climate adaptation for

the global poor and most climate vulnerable. In fact, using redundancy, modularity and diversity could even build equity, diversity and inclusion into the system.

There are two key considerations which must be considered when developing insurance climate adaptation products: potential land use and infrastructure consequences and risk transfer/displacement. Both pose challenges for any use of insurance in the climate adaptation space. However, if policy- and decision-makers consider both when developing or choosing insurance adaptation policies that are based on building in redundancy, modularity and diversity then both can also be overcome.

CHAPTER 6

CONCLUSION

6.1 Introduction

Considering that the Antarctic ice has more likely than not entered a melting phase that cannot be stopped within our human span of planning (Garbe et al., 2020) and the ocean currents and accompanying trade-winds are already altering their course (Seager et al., 2019), climate adaptation is becoming even more important than it already was. While every means to improve adaptation, especially for those who have not caused climate change but are disproportionately suffering the consequences, should be considered, past calls for urgency in other spaces have often justified or masked many inequitable and unjust policies (Stern, 2019; Van Wijk & Fischhendler, 2017). Therefore, any and all lauded adaptation approaches that the international community embraces should be subjected to serious scrutiny, especially adaptation approaches that are supposed to support the global poor and climate vulnerable but are initiated in a top-down manner (Marino & Ribot, 2012).

Climate change adaptation is a wicked problem without easily identifiable solutions that encompass complex interrelationships between system participants across multiple scales. Moreover, depending on how they are implemented, climate adaptation strategies could either reduce or increase inequities (Adger et al., 2005; Eriksen et al., 2011; Smit & Wandel, 2006). Climate change adaptation is a typical sustainability challenge which requires a recognition of interrelationships within the whole and integrates multiple disciplines to discover, create and rediscover approaches that begin chipping away at wicked problems (Kates, 2011; Lang et al., 2012; Westly et al., 2011).

This complexity across actors and scales only magnifies the difficulty of sifting out inequitable and unjust policies while retaining those policies that support just and equitable local adaptation solutions. One approach that enables this sifting process is using complex adaptive systems to

discover and understand the relationships between actors, scales, policies, system structures and outcomes. With this approach it is possible to consider and analyze interconnections and interrelationships, discover how these interconnections and interrelationships are structured, discover actual and potential impacts and, based on the analysis and discoveries, focus in on specific aspects of the system that are particularly influential or problematic.

Using this system view, it is also possible to highlight an often-unspoken piece within this process of sifting through policy choices: who is deciding what for whom. Who decides what climate adaptation is appropriate for whom has vast implications. Likewise, who determines how this adaptation will occur and when has enormous implications. Essentially, who is governing climate adaptation will impact what kind of adaptation an individual or local community will choose and what the implications will be for other surrounding households, communities and the larger political units to which the individual and community belong.

We often assume that those who are governing are governmental actors or at a minimum represent the government. However, with the rise of global environmental issues public-private partnerships have increased in importance. Partially, this is an attempt to leverage private finance, but it is also an attempt to find creative, sustainable solutions to pressing global challenges. One of the consequences is that private actors are having extensive influence in what earlier would have been solely public conversations and decisions (O'Brien et al., 2009). In the adaptation space, this influence impacts what kind of adaptation occurs and for whom. In particular, when global actors cross scales and influence what adaptation is happening at the local scale there may be unintended consequences.

Although there are many actors and policies formulated at the international level that would benefit from a complex adaptive systems lens and innumerable public-private partnerships instigated or funded at the international level, my dissertation focuses on actors, policies and partnerships within the climate adaptation space. More specifically, my research hones in on a

particular industry which has inserted itself into the adaptation space and which has been called, by too many to name, to be, enable and even force climate adaptation: (re)insurance¹.

Considering the complexity of climate adaptation and the global top-down nature of most of these calls for insurance in the adaptation space, a thorough examination of what kind of influence insurance yields within adaptation, what the consequences are for adaptation choices and who is deciding what adaptation is appropriate, is timely. This dissertation is one such timely attempt to begin unraveling the role and local adaptation impacts of insurance in the climate adaptation context. Broadly my dissertation uncovered whose risk was transferred where raising risk displacement, adaptation, justice and equity issues.

My dissertation uncovered four primary themes in adaptation policies which combine public and private governance, cross temporal and spatial scales and purport to solve local challenges with global solutions. The themes are complex relations in climate adaptation, emerging governance approaches in climate adaptation, equity and justice implications of emerging climate adaptation governance approaches and potential solutions. Within these themes there are both theoretical, policy and practice contributions.

6.2 Primary dissertation themes

Complex relations in climate adaptation

The dissertation first examined the entire 'insurance industry climate adaptation system,' its controversies and the issues and approaches that a systems approach illuminates.

The key theoretical findings were:

- There are two primary feedback loops by which a primary insurance provider exercises influence over a policy holder;
- One of the primary insurance provider feedback loops is a balancing feedback loop which keeps the system within 'risk' limits;

¹ (Re)insurance is one of the official manners to denote the entire insurance industry. However, the '(re)' unnecessarily complicates reading the text. Therefore, I am using insurance instead.

- The other feedback loop which primary insurance providers use is a reinforcing feedback loop which forces the system in one direction;
- This reinforcing feedback loop can be stronger or weaker, depending on the insurance program or product;
- Risk and finances are not the only ‘things’ that flow between the actors. Vulnerability also flows between the climate adaptation insurance system participants;
- Cross-scale interactions are going both directions;
- The primary insurance provider, reinsurance and the international financial market are tightly interconnected.

Each of these raise system questions for other global, cross-scale solutions for societal challenges which involve private actors. If the goals of the global solution do not fully align with the goals of the private actor, similar reinforcing feedback loops may exist. Similarly, the flows between actors do not always contain what international policy- and decision-makers may want. Presumably, no individual or organization wants to pass even more vulnerability to the global poor and climate vulnerable, however, the systems lens demonstrated that this is happening.

The systems lens also demonstrated that global insurance clearly was impacting local adaptation. This is, of course, the whole point of calling for insurance to be, enable or force adaptation. However, the impact of some local adaptations on global insurance often goes unrecognized and has far-reaching impacts. Indeed, some forms of local adaptation may pass enough vulnerability to the entire international financial market that they could cause a global financial crash. This vulnerability partially exists due to the tight interconnections between primary insurance providers, reinsurance and the international financial market and underlies one piece of the risk transfer/displacement issue. Thus, any global, cross-scale solution must examine the tight interconnections and interrelationships that may exist with that specific earth-system challenge arena. If the connections are as tight as in insurance, there may be undesired cross-scale interactions.

There are several key insights for policy that flow from the theoretical findings. Although these are generalizable to any insurance program or policy, they are not generalizable outside of insurance-related programs.

- The two different feedback loops drive contradictory policy choices at the local level.
- Insurance focuses primarily on sensitivity reduction and increasing general adaptive capacity, rather than reducing exposure.
- This focus drives the two different forms of adaptation.
- In the balancing feedback loop insurance sets rules to maintain its profit and protect its risk pools which in turn influence policy holders to reduce their sensitivity to climate events.
- In the reinforcing feedback loop insurance primarily focuses on increasing profit and maintaining spread, not on protecting its risk pool. In consequence, insurance still uses increasing generic adaptive capacity and sensitivity reduction but in a manner that completely disconnects these policy holders from the built environment.
- When there are contradictory development policies at the local level, one policy or program is using the balancing feedback loop and the other program or policy is located in or using the reinforcing feedback loop.

When insurance is using the balancing feedback loop, policy holders will be pressured to adapt in a manner that enables them to remain where they are, build back and eventually adapt to climate exposure. However, when insurance is using the reinforcing feedback loop insurance adaptation rules appear to pass risk on to others outside the risk pool, both financially and in the built environment. Furthermore, insurance programs located in this reinforcing feedback loop avoid policy holder risk reduction with the consequence that eventually these policy holders will lose their property or livelihood to climate change.

Because there are multiple types of property insurance and property insurance programs operating in many insured locations, local and regional governments sometimes simultaneously use contradictory development policies. Homes in one area may be bought-out while at the same time another location within the same floodplains may be developed.

Policy- and decision-makers can make use of these feedback loops. Laws, regulations and policies can push insurance products and programs into the balancing feedback loop which would achieve more, more appropriate and more just climate adaptation. These laws and regulations can be at any governmental level. Similarly, insurance could also choose to remain within the balancing feedback loop or to pressure governments to pass laws or regulations to force insurance and developers into the balancing feedback loop. This provides a range of options which both governments and private insurance could institute to be, enable and force climate adaptation.

Emerging governance approaches in climate adaptation

The influence that insurance clearly has over its policy holders opens up possibilities, one of which is examining insurance as governance. As this work developed, it became apparent that insurance is not always seen as a form of governance, least of all by policymakers and stakeholders responsible for decision-making in climate adaptation contexts. Yet, it was clear from my CAS work that insurance has and uses its influence to guide and often force policy holder decisions and choices.

The two key theoretical findings of this section are:

- Insurance can and often does function as governance.
- Insurance uses six tools to govern: change in premium, refusal to insure, risk reduction, information/data gathering, pressuring governments to enforce regulations or take measures and directly connect the biophysical circumstances to insurance.

Authors in sociology and legal studies (Ben-Shahar & Logue, 2012; Ericson et al., 2003) have both called insurance a form of governance before but none, as far as I could find, have specified exactly why insurance could be called governance and more specifically how insurance could carry out this governance. This contribution is important because it demonstrates, again, that private actors and public-private partnerships can and do govern even though both are still often excluded from this field (Chhotray & Stoker, 2009; Pierre & Peters, 2000). Equally important, insurance as governance can be used as a lens to further analyze insurance within the climate adaptation context.

The larger theoretical implication is that other private and public-private entities are probably also governing choices and actions within climate change and beyond. We know that many public-private partnerships are forming partially as a manner to address earth system challenges. These entities either already have or gain the ability to govern. However, if we are not using a governance lens to examine their actions, we may be missing key elements or building systems that we do not want.

There are multiple key insights for policy that flow from the insurance governance tools and the concerns that insurance governing adaptation raise.

- The insurance governance tools can be united with questions of who, what, where, when and why to form an insurance structural assessment which lay persons can use to assess insurance policies or programs in their location.
- There is a difference between risk and vulnerability. The two should not be conflated.
- Insurance, both public and private, will structure whatever the targeted social good is to the needs of insurance.
- Insurance shifts authority, both public and private, from governments to insurance companies, public-partnerships or insurance programs.
- Risk transfer, the goal of insurance, can also turn into risk displacement.

- Based on the insurance governance tools, alternative approaches that shift authority back to public government do exist.

The tools form the basis for a structural assessment which provides a straightforward and accessible insurance program and policy assessment for laypersons. First, the assessment enables decision-makers to see which insurance tools are used or not. Often the tools not used are just as important. Next, the insurance assessment can be used to analyze who, what, where, when and why a policy or program is benefiting who it is benefiting, who it claims to benefit and what types of benefits it may provide.

Insurance as governance raises four broad issues. First, although risk and vulnerability are often conflated, several authors have demonstrated that reducing risk does not automatically translate to reducing vulnerability (Montz et al., 2017; Sarewitz et al., 2003; White et al., 2001). Insurance as governance clearly demonstrated this issue in the Sundsvall case where reduced risk for some increased the vulnerability of others (Rohland, 2011a). This is also present in current agricultural adaptation insurance programs (chapter 4), private insurance products (chapter 2, 3 and 5) and certain rules and regulations of the National Flood Insurance Program and Community Rating System (FEMA, 2017; National Flood Insurance Act of 1968, 2019).

Second, insurance is based on actuarial science and/or catastrophic modeling to protect its profit if it is a private company or to break-even if it is a public program. In public-private partnerships, the private partner still must make a profit. To do so insurance is willing to structure adaptation according to its needs and not per se what local communities need. This has a second consequence, insurance may shift authority away from local communities, cities and even States to private insurance companies and other non-state actors.

Both of these consequences lead to a final issue which decision-makers must be aware of, risk displacement. The transfer of individual policy holder's risk to the private insurance provider is

the goal. However, this transfer can shift both financial and physical risk onto others. Within indemnity insurance there are rules to deal with moral hazard and adverse selection which both displace risk within the risk pool. Parametric insurance, however, can ignore both. However, there is also risk displacement to other networked layers and to the public.

This risk displacement has been demonstrated historically and is currently occurring at the global scale. After the 1906 Great Fire in San Francisco, the risk of this high value, high risk location was transferred to the global market while the insurance companies kept the profit (Rohland, 2011b; Rohland, 2012). Similarly, many insurance companies are remaining in Florida because the market is lucrative. However, to protect themselves they are passing their risk to the international financial market, premium payers around the world, and if everything goes wrong taxpayers to bail them out (Johnson, 2014; Medders, 2017).

This risk transfer and displacement highlights one of the tools that policy- and decision-makers could use to shift the displacement back to the transfer that it is supposed to be. Coupling insurance to the biophysical circumstances maintains the balancing feedback loop discussed in chapter 2 through reducing risk exposure. This tool can be used at the local, regional, national and even international scales.

Equity and justice implications of emerging climate adaptation governance approaches

The critical questions within the structural assessment also enable policy and decision makers to analyze the justice and equity implications of insurance programs or policies. As mentioned in the introduction to this chapter climate change adaptation is a wicked problem. One of the reasons for this is the interplay of distributional, procedural and recognition issues within climate change itself and climate change adaptation. Those who caused climate change are not the people who are paying the greatest costs in suffering the consequences of climate change. Those who have contributed the most to climate change are also not, for the most part, already forced to adapt, and, if they do need to adapt, they have the financial means. Furthermore, those

who are forced to adapt, already suffering the consequences and financially on the edge or below, have largely been left out of any processes to rectify climate change or have been marginalized in those processes². Essentially, all climate change adaptation solutions are laced with justice and equity issues because of the underlying issues within climate change (Marino & Ribot, 2012).

In the case of insurance in the adaptation context, these international insurance programs and calls for insurance in the adaptation space stress the potential to reduce the vulnerability of those who are the poorest and those who have the most climate risk throughout the globe (InsuResilience, 2017; Schäfer et al., 2016). This implies that justice should be central to these programs. However, justice in the climate change context is not only about distribution, in this case transferring financial support to the poorest and most climate vulnerable. Therefore, I examine the justice implications of insurance in the adaptation context using a multivalent justice approach (Klinsky 2015; Klinsky & Winkler 2018).

The key theoretical contribution of this portion is:

- The multivalent justice approach provides a means to assess the consequences of using insurance as governance.

Often when people or policies address justice they only consider one piece, usually who gets what. However, this distributional aspect of justice is only one part of the story in climate adaptation, and any other large-scale earth system challenge. Climate adaptation and other large-scale challenges are also about procedure – how one goes about the process of adaptation including how decisions are made. In addition, who is included in the decision-making process, who gets to decide and influence how one proceeds and who is considered a stakeholder are key components. This last piece of multivalent justice is called recognition justice.

² See Local Communities and Indigenous Peoples Platform at United Nations Framework Convention on Climate Change to begin rectifying this issue. <https://unfccc.int/LCIPP>

Based on the insurance as governance assessment and then the multivalent justice approach, the outcomes of the assessment produced three key findings relevant for policy.

- As currently utilized in agricultural crop-insurance contexts, insurance may have limited capacity to enable adaptation to climate change.
- There are often trade-offs between short and long-term distributive justice implications within insurance program designs.
- Procedural and recognition justice have been sparsely documented, making empirical analysis difficult and highlighting the potential challenges insurance as currently implemented may pose for these justice dimensions.

If policy- and decision-makers are truly attempting use insurance to be, enable or force climate adaptation within agricultural crop contexts, there will have to be some drastic changes. Although insurance may be enabling adaptation to the financial market, improving financial circumstances does not automatically translate into sustainable adaptation. In fact, insurance often did not support sustainable adaptation options.

Second, the trade-offs between short and long-term adaptation choices raise distributional justice issues. If the financial risk lodges with the governments of the poor and vulnerable this could undermine the capacity of these governments in other areas. Moreover, if the insurance is not linked to exposure reduction, the adaptation may provide results in the short-term but erode the long-term sustainability of the program both at the individual level through soil or land degradation or at the state level if farmers become dependent on insurance subsidies to survive.

Finally, either scholars and those reporting on the programs are not interested in procedural and recognition justice, or the programs do not include either. Procedural and recognition justice were so sparsely documented that it is impossible to determine if some of the programs even realized that procedural justice existed let alone recognition justice.

These findings raise pointed questions about the ability of insurance to function as adaptation and/or to drive adaptation but they also raise broader fundamental issues for policy- and decision-makers. If decision-makers are aiming for climate adaptation, they will need to consider the long-term. Although the planet is already experiencing some of the consequences of a changing climate, this is only the beginning. Arguably a functional agricultural sector is also important but an agricultural sector that cannot survive the changing climate may actually be maladaptation (Müller et al., 2017). Moreover, the distributional implications of short-term financial gain but long-term soil and land loss suggest that to retain a functional agricultural sector decision-makers should be considering distributional justice explicitly.

Similarly, although the programs, with the exception of one, did not truly address procedural and recognition justice, the one program that did was growing without any extra advertising (chapter 4). This suggests that if policy- and decision-makers want a program to succeed and grow then including procedural and recognition justice would be a good place to start.

Potential Solutions

Despite the short-comings and justice issues insurance in the adaptation context raises, there are potential applications which could be used to formulate, discover and develop effective and just insurance for adaptation programs or products. There are several overarching findings which emerge throughout the entire dissertation and are assembled in chapter 5.

The theoretical contributions are:

- The CAS lens suggests alternative research approaches which would provide other insights into insurance within the adaptation context.
- Redundancy, modularity and diversity are all severely lacking in the insurance climate adaptation system.

Challenges such as climate adaptation cannot be 'solved' with one lens or discipline. My dissertation focused in on insurance as governance because of the many international calls for insurance to be, enable and force climate adaptation. However, the alternative research approaches in chapter 5 would all contribute to developing more just and equitable insurance climate adaptation products.

Key in this development are the theoretical insights from CAS. Redundancy, modularity and diversity are all woefully lacking in insurance. This absence is one of the reasons that risk is sometimes displaced instead of transferred, vulnerabilities flow between participants as freely as finance and risk, and the entire global financial system is vulnerable to concentrated, high-risk, high-value, densely insured geographical locations.

However, this specific theoretical insight forms the foundation for the first of three policy insights and impacts the second and third as well:

- Building redundancy, modularity and diversity into the system is possible and could support more equitable, diverse and inclusive insurance programs.
- Before developing or instituting an insurance climate adaptation program decision-makers should consider what the infrastructure and land use implications will be.
- Before developing or instituting an insurance climate adaptation program decision-makers should consider whether the program will remain a form of risk transfer or if the insurance rules or programs rules will drive the program to become a form of risk displacement.

Building in redundancy, modularity and diversity would contribute to insurance achieving its purported goal of supporting climate adaptation for the global poor and most climate vulnerable. In fact, using redundancy, modularity and diversity could even build equity, diversity and inclusion into the system. This is an achievable goal since all three can be connected to the current insurance system.

However, there are two key considerations which policy- and decision-makers must consider when developing insurance climate adaptation products: potential land use and infrastructure consequences and risk transfer/displacement. Both pose challenges for any use of insurance in the climate adaptation space. However, if policy- and decision-makers consider both when developing or choosing insurance adaptation policies that are based on building in redundancy, modularity and diversity then both can also be overcome.

6.3 Conclusion

Based on the findings of my dissertation there are many challenges to using insurance in climate adaptation. However, there are also many exciting opportunities that could further justice and equity within insurance climate adaptation programs. These opportunities need more research and practical application.

In the meantime, there are pressing questions that impact local, regional and global adaptation. How do ILS products in less-wealthy countries impact the adaptation options of the rest of the population? In the Caribbean, how do high risk, high value coastal properties impact the ability of the rest of the coastal inhabitants to adapt and to withstand hurricanes? In the United States, how does the National Flood Insurance Program impact the provision of private insurance of all types for high value high risk locations? What is the global impact of enabling and allowing concentrations of high risk, high value properties? What other forms of undesirable risk transfer are occurring that are masked through the complex interrelationships between all forms of insurance? What key aspects of the system could be altered to begin the slow process of removing risk displacement while retaining risk transfer?

These questions all refer specifically to insurance in the climate adaptation space. However, there is a broader context. The international calls for insurance which this dissertation discussed in the introduction are primarily in the form of public-private partnerships. As mentioned at the

outset of this chapter, there are many public-private partnerships at the international level which intend to influence local societies in some 'good' manner. Many of the partnerships will or are already struggling with similar challenges that insurance has in the climate adaptation space. Most international partnerships will, purely by their scale, run into similar power relationships which could result in unintentional governance of local choices and actions. Likewise, those power relationships can influence the distributional, procedural and recognition justice of the intended programs. Of course, this does not need to be negative. The solutions portion of this dissertation and some of the laws and regulations mentioned in chapter 3 not only decrease injustice but also could build in justice considerations as well as effective climate adaptation. My hope is that this dissertation will not only contribute to insurance policy and decisions in the climate adaptation space but also to policy and decisions in global cross-scale public-partnerships attempting to address our earth system challenges.

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APPENDIX A

FIGURE 1 – FULL SIZE

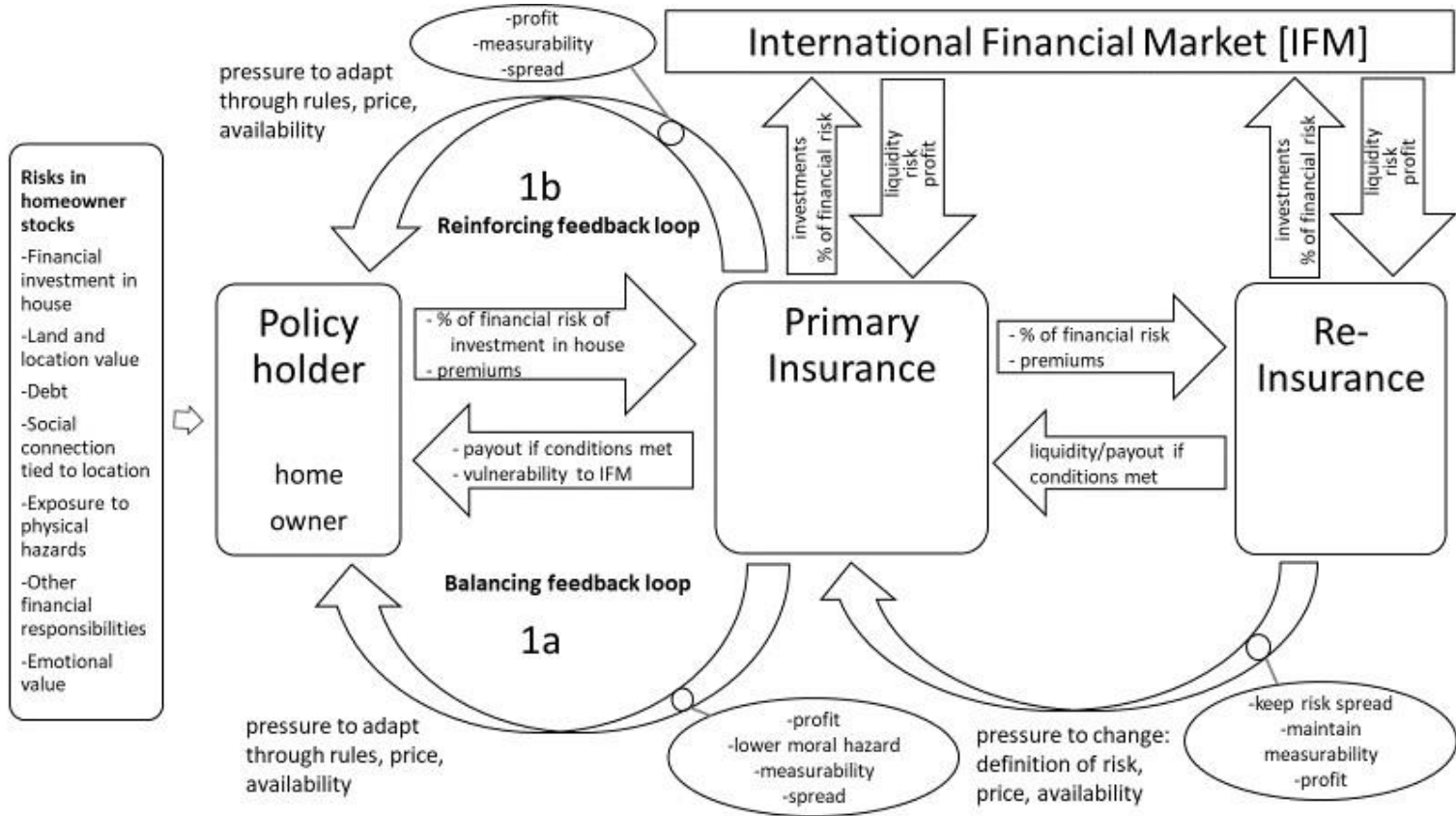


Diagram 1 Simplified stock and flow diagram: the policy holder stock represents all policy holders with the example of a residential homeowner in Florida. This example demonstrates what composes the policy holder risk stock and what is flowing out. The primary insurance stock represents all primary insurance providers. The reinsurance stock all reinsurance providers.

APPENDIX B
INSURANCE TOOLS

Insurance tool	reference(s) and short example(s)	why	active scale - Insurance provider	active scale - policy holder	form - private, non-profit etc.
change in premium (increase/decrease)	Rejda & McNamara (2013); Plitt et al. (1995-date) - for any insurable thing or situation; Ben-Shahar & Logue (2012) - for autos, environmental regulations	supports measurability, predictability, liquidity; diminishes risk transfer within pool and moral hazard	region, national, international	individual policy holder - can range from one single individual to countries pooling together such as the Caribbean Catastrophe Risk Insurance Facility	private, public, public-private partnership, profit and non-profit
refusal to insure	Rejda & McNamara (2013); Plitt et al. (1995-date) - for any insurable thing or situation	supports measurability, predictability, liquidity, and spread; diminishes risk transfer within pool and moral hazard	region, national, international	individual policy holder - can range from one single individual to countries pooling together such as the Caribbean Catastrophe Risk Insurance Facility	private, public, public-private partnership, profit and non-profit
risk reduction	Rejda & McNamara (2013); Plitt et al. (1995-date) - for any insurable thing or situation; Rohland (2011a) - forcing to rebuild in stone	supports measurability, predictability; diminishes risk transfer within pool and moral hazard	region, national, international	individual policy holder - can range from one single individual to countries pooling together such as the Caribbean Catastrophe Risk Insurance Facility	private, public, public-private partnership, profit and non-profit
information/data gathering	Rejda & McNamara (2013); Plitt et al. (1995-date) - for any insurable thing or situation; Ward et al. (2008) - wind damage information to policy holders	supports measurability, predictability, and spread; diminishes moral hazard	region, national, international	individual policy holder - can range from one single individual to countries pooling together such as the Caribbean Catastrophe Risk Insurance Facility	private, public, public-private partnership, profit and non-profit

pressuring governments to enforce regulations or take measures	Huber (2004) - British private insurance pressured government to enforced current rules and enact more stringent rules	supports measurability, predictability; diminishes risk transfer within pool and moral hazard	region, national, international	individual policy holder - can range from one single individual to countries pooling together such as the Caribbean Catastrophe Risk Insurance Facility	private, public, public-private partnership, profit and non-profit
coupling between insurance & biophysical	Huber (2004) - British private insurance pressured government to enforced current rules and enact more stringent rules; Crichton (2008) - Swedish private insurers can sue local governments for damages if building permits are granted in inappropriate locations	supports measurability, predictability, spread and avoiding correlation; diminishes risk transfer within pool and moral hazard	region, national, international	individual policy holder - can range from one single individual to countries pooling together such as the Caribbean Catastrophe Risk Insurance Facility	private, public, public-private partnership, profit and non-profit

Table 1 The left column contains the insurance tools and the top row contains the insurance elements which are absolutely necessary to carry out insurance and, in the case of profit companies, maintain a profit.

APPENDIX C

SUNDSVALL DEMONSTRATION OF INSURANCE TOOLS

Insurance tools	Adaptation questions				
		What and for who	where	why	When
risk reduction	risk reduction - reinsurance company	Reduce financial risks for company (in this case companies)	Inter-nationally	Protect profit	After massive fire that burned most of Sundsvall
	risk reduction – insurance companies	Reduce financial risks for Swedish insurance companies	Sweden	Guarantee continued coverage by reinsurance and reduce premiums	After reinsurance was considering refusing to insure
	risk reduction - city	Reduce potential for city-center wide fire	Sundsvall, Sweden	To reduce premiums to insurance	After insurance raised their premiums and threatened to refuse insurance
	risk reduction individual policy holders	Reduced potential for burning of their home but only for those who could afford to rebuild in stone	City center Sundsvall, Sweden	To get insurance coverage and to live in the city center	After city negotiated deal with insurance companies
increase in premiums	Reinsurance increased premiums	Swedish insurance companies providing insurance to cities and individuals	Sweden	Protect profit and liquidity and cover loss	After fire
	Swedish insurance companies increased premiums	Sundsvall and cities built in wood, and individual policy holders	Sweden, Sundsvall	To Guarantee coverage by reinsurance companies; to protect profit and cover loss	After fire
refusal to insure	Reinsurance	Discussed refusal to reinsure Swedish cities	Sweden	To protect spread and profit	After fire

	Swedish insurance companies	Cities with a certain percentage of wood;	Sweden and Sundsvall	To lower premiums, protect profit and liquidity	After fire
	Swedish insurance companies	individual private wooden buildings	In Sundsvall city center	To lower premiums, protect profit and liquidity	After fire
	Swedish insurance companies	individual private wooden buildings	Wherever were built	To lower premiums, protect profit and liquidity	After fire
information/data gathering	Reinsurance companies	Hired individual to gather information on the fire for reinsurance claims process	Sweden	To calculate loss (measure) and plan for future (predictability)	After fire
	Swedish insurance companies	Not available			
pressuring governments to enforce regulations or take measures	Reinsurance companies	Indirectly pressured Sundsvall to rebuild in stone	Sundsvall	To protect spread and profit	After fire
	Swedish insurance companies	Pressured Swedish cities, in this case Sundsvall, to rebuild in stone	Sundsvall	To lower premiums, protect profit and liquidity	After fire
coupling between insurance & biophysical	none	none	none	none	None

Table 2 Illustration of structural assessment using Sundsvall insurance case (Rohland, 2011a).

APPENDIX D
AGRICULTURAL CASE DESCRIPTIONS

Case	Key Points
India (Adegoke et al. 2017; Swain 2014)	<ul style="list-style-type: none"> • 18 states covered by weather index insurance • intended to support adaptation under climate-smart agriculture • weather index insurance (with some information on yield-based insurance) • insurance is linked to loans, but is not required • premiums are heavily subsidized by government (50-70%) • targets all farmers including sharecroppers, tenant cultivators, those with government loans and those without • information from specialists • little participation policy holders
West Africa (Adegoke et al. (2017)	<ul style="list-style-type: none"> • Senegal, Mali, Burkina and Ivory Coast • intended to contribute to resilience and therefore climate adaptation • index insurance for loans, required • donors present but not clear who gets subsidized – farmer premium or financial institution directly • targets poor, small climate change vulnerable farmers • minimal participation policy holders
R4 (Horn of Africa including Ethiopia) Adegoke et al. (2017); Peterson (2012); Meze-Hausken et al. (2009)	<ul style="list-style-type: none"> • Ethiopia, Senegal, Malawi, Zambia and Kenya • Improve resilience & food security of climate vulnerable rural households • Index insurance linked to loans but not required • UN World Food Programme and government fund and has donors but not clear who gets subsidies • Targets uninsurable • Information from specialists to local knowledge providers • High participation policy holders • Recognizes communal components of local society • Attempts to fit with local coping strategies
ACRE Adegoke et al. (2017)	<ul style="list-style-type: none"> • Began in Kenya and is spreading in Sub-Saharan Africa • Intended to reduce vulnerability to climate change shocks • Index insurance linked to loans but not required • For-profit with goal of reducing transaction costs • Seed company subsidizes first seed-packet • %50 premium subsidies for initial premium but is not clear who pays this subsidy • Targets any farmer who can pay and has a cell phone • Information from specialists • Little to no participation policy holders
Suarez & Linnerooth-Bayer (2010); Meze-Hausken et al. (2009); Hochrainer et al. (2009); Osgood et al. (2008)	<ul style="list-style-type: none"> • Intended to drive or be climate change adaptation • Index insurance linked to loan, required • Supported through donor organizations and local financial institutions; not clear who received the donations but supposed to operate without subsidies • Targets poor and vulnerable farmers • Information from specialists • Some participation of policy holders
Nigeria Adegoke et al. (2017)	<ul style="list-style-type: none"> • Intended to support climate change adaptation • Index insurance may be linked to loans • May be donors and subsidies but not clear

	<ul style="list-style-type: none"> • Targets smallholder farmers • Intended to have high participation by policy holders
Austria Hochrainer-Stigler & Hanger-Kopp (2017)	<ul style="list-style-type: none"> • About including hypothetical climate connected insurance in Austrian disaster insurance • Subsidized by government and provided by private insurance • Targets farmers • Directly coupled to the changing climate

Table 3: Case descriptions

APPENDIX E

INSURANCE AS GOVERNANCE STRUCTURAL ASSESSMENT

Insurance tools	Cases						
	India	West Africa	R4	ACRE	Nigeria	Malawi	Austria
risk reduction							
• For farmers (extreme coping measures)	yes	yes	yes	yes	yes	maybe	yes
• For farmers (agriculture)	no	no	yes	no	maybe	no	maybe
• For local financial institutions	yes	yes	yes	yes	yes	yes	yes
• For international financial institutions	N/A	yes	yes	yes	maybe	yes	no
increase in premiums	maybe	yes	maybe	maybe	N/A	yes	maybe
refusal to insure	yes	yes	yes	yes	yes	yes	yes
information/data gathering	yes	yes	yes	maybe	yes	yes	yes
pressuring governments to enforce regulations or take measures	no	no	no	no	no	no	maybe
coupling between insurance & biophysical	no	no	yes	no	no	no	yes

Table 4: Insurance as governance structural assessment. The first column contains the tools and the questions who and for what. The assessment uses: yes, if the tool is clearly used; no, if the tool is not used; and maybe if the tool could be implied but is not clear.

APPENDIX F
ARTICLES IN REVIEW

Chapter 3 is in review as an article. It was submitted in July 2020. The reference is: Lueck, V. (*in review*). Governing climate change adaptation through insurance: a risky business?

Chapter 4 is in review as an article. It was submitted in September 2020. The reference is: Lueck, V. & S. Klinsky (*in review*). Leveraging insurance for climate change adaptation: possible concerns for justice?