Climate Change and the Caribbean: A Multi-Scalar Account of Context and Inequality

Introduction

The form and severity of climate change impacts are and will be differentially experienced by people around the world. The influence of climate change on social systems is contingent reflected in the discourse of human-environment relations. Grasping *how* and *to what degree* human systems and the natural environment interact are but some of the basic prevalent enquires. Vulnerability reflects such considerations, comprised of the intensity and frequency of a natural hazard, and the geophysical and social (*e.g.*, socio-economic, political, *etc.*) characteristics of a human system, all of which affect its exposure and response (Kelly & Adger, 2000; Adger, 2006; Wisner *et al*., 2004; O'Brien *et al*., 2007).

Vulnerability is operationalized in the decision-making for global scale climate policy. The United Nations Framework Convention for Climate Change (UNFCCC) evidently relates vulnerability to just process and outcome in the principle of 'common but differentiated responsibilities' (UNFCCC, 1992: Article 3(1)): actualizing the Rawlsian conception of 'justice as fairness'. This concept entails identifying and adjusting the procedures and distribution of policy in the interests of the most vulnerable stakeholders (Barrett, 2012; Rawls, 1972). Barrett (2012) demonstrates that this conception of climate justice necessitates a multi-scalar framework, insofar as justice is only actualized upon promoting the adaptive capacity of the most vulnerable in local scales. How vulnerability is differentiated throughout this multi-scalar framework of climate justice is an indispensable consideration—one which is fundamental to the current analysis.

Small island developing states (SIDS) are frequently noted as being among the most vulnerable groups in the world; geophysical smallness, spatial remoteness, and the resultant dependence upon the global market for resources engender a socio-economic vulnerability that is amplified by climate change (Nurse *et al*., 2014; Pelling and Uitto, 2001; Kelman, 2010; Briguglio, 1995). In the global scale, climate justice is pursued by the Alliance of Small Island States (AOSIS), a group united by forty-four SIDS throughout the world (Betzold, 2010; Benwell, 2011; Bishop & Payne, 2012). Disproportionately high vulnerability begets a unique position for AOSIS. On the one hand, by manipulating its 'victim status', SIDS have attained some success in encouraging urgency and discussions of equity within negotiations. On the other hand, the ambitious mitigation and adaptation targets they strive for have often been left marginalized under the more dominant interests of developed parties (Benwell, 2011; Betzold, 2010; Byrne & Inniss,

2002). This historical imbalance in achieving procedural but not distributional achievements persists into the present, with the Paris Climate Agreement as recent testament (Hoad, 2016).

The implications of these failures is global scale climate justice are then examined on smaller scales. Regionally, the Caribbean maintains economic similarities with other regions of SIDS, especially in its status as the most tourism-intensive economy in the world—an exemplar of a trend enabled by the withering influence of small island agriculture in the global market (Nurse *et al*., 2014; Bishop & Payne, 2012). However, both tourism and agriculture are climate-sensitive; and how these major sectors are vulnerable is, therefore, of significant consequence to Caribbean livelihood.

Like the global scale, vulnerability is differentiated within the regional scale: the spatial orientation and varying socio-economies of Caribbean SIDS point to this fact. Yet, differential vulnerability is visible within the national scale as well. With an overlap of a vertical (*i.e.*, scalar) analysis of climate justice with a horizontal (in this case, sectoral), the analysis reveals differential vulnerability between and within tourism and agriculture in a case study of Jamaica, arising from varying climate-sensitivities and social contexts (*e.g.*, government support, the conditions of local and global markets, *etc.*). Isolated local scale examinations differentiate vulnerability further and often expose winners and losers both in responses to climate change and the global market (Leichenko & O'Brien, 2008).

In agreeance with Barrett (2012), this work asserts that climate justice, a virtue upheld by the UNFCCC, is fully actualized upon improving the adaptive capacity of the most vulnerable—that is, local stakeholders who directly experience and respond to climate change (Adger, 2001). With SIDS, the Caribbean, and Jamaica as global, regional, and national case studies, a multi-scalar framework is adopted in this work. Structural inequalities, generated by pre-existing socio-economic and political conditions, are fomented by climate change; and with the needs of the most vulnerable marginalized by these circumstances, winners and losers may emerge (Fisher, 2015; Barrett, 2012; O'Brien *et al*., 2007; Leichenko & O'Brien, 2006).

In brief, the present work is an examination of differential vulnerability as it exists in multiple scales and sectors and its implications on climate justice. Section II details the conceptual framework, defining terms and approaches utilized throughout the work. Section III commences the multi-scalar examination; SIDS are selected as a case study, and AOSIS's historical achievements and shortcomings in procedure and distribution are assessed. Section IV details the vulnerability of the Caribbean as a region, mentioning historical and predicted trends in climate change impacts. These impacts are then economically contextualized through a national analysis of production in Jamaican tourism and agriculture. Here, local assessments of vulnerability and

adaptive capacity are made, and some groups are identified as being more vulnerable than others, not only to climate change, but to globalization as well. Section V concludes the work, with reflections on instances of structural inequality within the examined scalar and sectoral case studies, and suggestions of future directions for research regarding the operationalization of vulnerability in climate policy.

Conceptual Framework

In studies of global change, vulnerability is a term frequently used by a number of disciplines; likewise, it entails a number of nuanced interpretations as well as conceptual frameworks (Adger, 2006; Wisner *et al*., 2004; O'Brien *et al*., 2004). With reference to human-environment relations, however, these varying conceptions can be reduced to reveal a common utility for the term: namely to describe the pre-disposition and potential response of an exposure frame (*viz.*, a defined social unit of study) to the pressure of an external process (Adger, 2006; Rhiney, 2015). In this work, *pre-disposition* is defined by the geographic (*viz.*, spatial and physical) and pre-existing social (*e.g.*, socio-economic, political) conditions of an exposure frame; and *response* refers to how an exposure frame copes with or adapts to external pressure. An *external pressure* can be categorized as either an episodic, acute *shock* or a persistent, chronic *stress* to an exposure frame; thus, the duration, frequency, and intensity of an external pressure are also pertinent to vulnerability assessments (Wisner *et al*., 2004).

The multiplicity of vulnerability interpretations is significant insofar as it has implications on how the term is operationalized both in research and policy (O'Brien *et al*., 2004). O'Brien and colleagues (2007) note that, in essence, frameworks generally incline towards studies of *outcome* or *contextual* vulnerability, both of which enable different enquiries to be pursued. For example, whereas assessments of outcome tend to identify vulnerable groups and measure the extent to which they are vulnerable, those of context consider the root socio-economic and political causes of a group's vulnerability. Recent policy, often designed in strict reference to biophysical data, tends to overlook the latter, and can be found failing to achieve sustainable development by consequence (O'Brien *et al*., 2007; Kelman, 2014; Barrett, 2012; Adger, 2006; Kelly & Adger, 2000). Adaptive capacity is not merely determined by *what* resources are distributed; rather, *how* they are distributed—that is, the entitlement (*i.e.*, access) of local populations to them—is also a vital consideration (Kelly & Adger, 2000: 330). Therefore, the awareness of pre-existing socio-economic conditions of civil society and the institutions which define and grant entitlements are essential to effective climate policy (Adger, 2003; Barrett, 2012; Fisher, 2015).

To compliment an understanding of the socio-economic conditions unique to an exposure frame, a study of globalization is useful. The influence of the liberalized global market is far-reaching, extending into domestic markets and shaping livelihood on local scales (Leichenko & O'Brien, 2008). This is especially true of small island developing states (SIDS) which, in often lacking domestic resources, are heavily reliant upon the global market (Briguglio, 1995; Pelling & Uitto, 2001). As a result, SIDS economies are sensitive to perturbations in the market, thereby affecting the context by which they are vulnerable to climate change. That globalization and climate change are related systems is made further apparent in the climate-sensitivity of tourism and agriculture—the two major sectors of many SIDS economies—as alterations in climate can be reflected in production (Nurse *et al*., 2014; Pelling & Uitto, 2001). Hence, climate-sensitivity serves as a nexus for climate change and globalization in SIDS. Leichenko and O'Brien's (2008) Double Exposure Framework not only relates these two processes, but reveal them to often be *synergistic*: the response of an exposure frame to one process can alter the context for the other—exacerbating existing vulnerabilities and potentially engendering new ones. This approach to contextual vulnerability is employed in an examination of Jamaican tourism and agriculture, revealing differential vulnerability to exist between and within these sectors.

Differential context implies a differential pre-disposition and capacity to adapt to climate change and globalization. This relationship emerges in every analytical scale. Thus, as Barrett (2012) suggests, a multi-scalar framework is central to meaningful discussions of climate justice. Entitlements of rights and resources—the elements of adaptive capacity—are contingent upon the process and outcomes of climate policy (Kelly and Adger, 2000; Burnham *et al*., 2013). - Climate change and globalization generate and foment existing inequalities in multiple scales (Leichenko & O'Brien, 2008); the achievement of climate justice lies in overcoming these inequalities and ensuring entitlements to the most vulnerable stakeholders found in local scales (Barrett, 2012; Fisher, 2015). This work is an attempt to contribute to this enterprise, namely with analyses of both outcome and contextual vulnerability as it is exists, differentially, in global, regional, national, and local scales.

SIDS and the Political Context of Vulnerability

Small islands are increasingly distinguished as being among the most vulnerable group of nations in the world (Nurse *et al*, 2014; UNFCCC, 2015). The Fifth Assessment Report (AR5) published by the Intergovernmental Panel on Climate Change (IPCC) in 2014 notes many small islands to be spatially and geophysically pre-disposed to experience adverse effects from multiple shocks

(*e.g.*, hurricanes, episodes of heavy rainfall) and stresses (*e.g.*, rising mean annual temperatures, changes in precipitation patterns, and sea-level rise). The need to examine vulnerability is highlighted by the heavy dependence of many small islands on tourism and agriculture—two climate-sensitive forms of production. As AR5 duly notes, however, notwithstanding several commonalities, the context for climate vulnerability cannot be neatly homogenized to include all small islands (Nurse *et al*., 2014: 1618); and despite the following distinction of small island developing states (SIDS) and the assumption of some common geographic and social contexts between them for the sake of analysis, that they are, indeed, differentially vulnerable is a fact that cannot be dispensed with here nor in policy-making (Kelman, 2014).

Yet, without entirely casting away differential vulnerability, it can at least be said that SIDS share the traits of smallness and remoteness; albeit to varying degrees, both geographic features are economically relevant and construct similar contexts for climate vulnerability (Pelling & Uitto, 2001). Smallness begets small economies, limited in both physical and social capital, and renders SIDS deeply reliant upon external inflows of resources (Briguglio, 1995; Bishop & Payne, 2012). Thus, participation in the global market is critical to economic sustainability and growth. With economic potential deprived by smallness, many SIDS are unable to diversify their exports, thereby whittling away competitive advantage and yielding trade deficits and debts to be borne (Pelling & Uitto, 2001; Briguglio, 1995; López-Marrero & Wisner, 2012). Remoteness increases the time and costs associated with the external transportation, affecting access to not only physical capital (*viz.*, through imports) but social capital as well (Pelling & Uitto, 2001; Briguglio, 1995). Thus, both smallness and remoteness and their socio-economic consequences engender the context for climate vulnerability in SIDS—a pre-disposition to experience significant economic loss with a limited capacity to sustainably cope and adapt.

Based on these similarities in contextual vulnerability, forty-four SIDS jointly negotiate as the Alliance of Small Island Developing States (AOSIS) in the process for global scale climate policy (Betzold, 2010; Benwell, 2011; Bishop & Payne, 2012). Historically, AOSIS have consistently referenced to the disproportionate vulnerability of its constituents, while highlighting that their collective contribution to climate change (*via* greenhouse gas emissions) is negligible (Betzold, 2010; Benwell, 2011; Kelman, 2014; Nurse *et al.*, 2014). Indeed, AOSIS regularly assumes a *moral* approach within negotiations, such that the severe vulnerability of SIDS is utilized as a goad to encourage the urgency in and steer the direction of negotiations (Benwell, 2011; Betzold, 2010).

AOSIS's employment of its 'victim status' is traceable in its contributions to the drafting of the UNFCCC. Through referencing to empirical research, AOSIS was able to portray its

constituents as being among the first and most vulnerable to the effects of climate change, despite having contributed the least to it—shaping the normative foundations of the Framework Convention in effect (Benwell, 2011; Betzold, 2010). This is, for example, apparent in the principle of 'common but differentiated responsibilities' (UNFCCC, 1992: Article 3(1)); in conjunction with considerations of 'historical and current emissions from developed countries' (Article 4), the pertinence of differential vulnerability and historical emissions to procedural justice is a testament to AOSIS's success in wielding its status. In addition, the Precautionary Principle (Article 3(3)) spurs decision-making in the face of scientific uncertainty. For SIDS, much of who are the front-line states to experience the adverse impacts of climate change first, the achievement of speed in negotiations indicates another victory in favorably adjusting procedures (Benwell, 2011). Thus, the operationalization of procedural justice—that is, the practical implications of the term in policy-making—is largely a product of AOSIS's progress in conveying the disproportionate vulnerability of SIDS. Smallness, albeit a cause to this vulnerability, ironically lends this political leverage (Benwell, 2011; Betzold, 2010).

The extent of this normative power over *procedures*, however, is marked by shortcomings in achieving desired *outcomes*. History suggests that value-claiming achievements, such as mitigation and adaptation objectives, have been relatively elusive for AOSIS. Here, the contextual vulnerability of SIDS is to their political detriment, as the unique needs and interests of small islands are not commonly shared (Benwell, 2011; Bishop & Payne, 2012). Even the Group of 77 (G-77) and China, a negotiating group of which many SIDS are also members, often maintains disagreeing views. Though comprised too of developing nations, the geographic, socio-economic, and political contexts of G-77 and China's constituents widely vary. For example, in contrast with the low greenhouse gas emissions of many SIDS, some members have among the highest emissions in the world (*e.g.*, China, India); other nations are economically reliant upon oil production, including even the Caribbean small island of Trinidad and Tobago (Bishop & Payne, 2012). Indeed, to these nations, 'per capital rights' is frequently an aim as far as fossil fuels are critical to improving standards of living, whereas mitigation may hinder immediate goals of economic development (Bishop & Payne, 2012; Benwell, 2011). Despite the benefits inherent in solidarity with G-77 and China, maneuvering through a political context in which the vulnerability of parties is differential, and not necessarily proportional to power, has proved to be challenging to AOSIS.

Immediate and deep cuts in emissions, as well as greater and better managed relief efforts, while necessary, place AOSIS in an unfavorably ambitious position within negotiations. The outcomes of the Kyoto Protocol (1997) and the Copenhagen Accord (2011) both testify to the

continuing difficulty of AOSIS to achieve its objectives in mitigation and adaptation. In the drafting of the former, AOSIS had pressed for a 20% reduction in 1990 levels of greenhouse gas emissions by the 2008 to 2012 period; the Kyoto Protocol, on the other hand, established a 5% reduction target (Byrne & Inniss, 2002; Benwell, 2011). This disparity largely resulted from the more dominant concerns of economic efficiency within negotiations, especially for major emitters (*e.g.*, the United States) (Byrne & Inniss, 2002: 17). From this vein arose various flexibility mechanisms (*e.g.*, emissions trading, Joint Implementation, the Clean Development Mechanism) designed to diminish the costs associated with adopting this target. Although this may be the case for some parties, Byrne and Inniss (2002: 17, 18) argue that emissions trading systems are not particularly useful to SIDS: having low emissions to start with and lacking the resources to create a reductions project attractive to foreign investment, SIDS are relative losers in the emissions trading regime. Furthermore, though the regime is legally-binding, the emissions market is difficult to monitor and may, overall, be ineffective in yielding the transitions in technology necessary for sustainable development (Bryne & Inniss, 2002: 19). Both in the means and ends it established, the Kyoto Protocol, if not a failure, at least stands as a notable shortcoming of AOSIS in its mitigation objectives.

A similar pattern was apparent in the drafting of the Copenhagen Accord: AOSIS proposed relatively ambitious targets, only to be marginalized, again, in discussions of economic efficiency. As negotiations comprised of namely BASIC (Brazil, South Africa, China, India) and the United States, the political presence of AOSIS was relatively non-existent (Benwell, 2011; Bishop & Payne, 2012). Expectedly, its objectives were unsatisfied. With BASIC and the United States both unwilling to comprise and reluctant to commit to substantial cuts in emissions, a target of a 2 ºC limit to global warming was ultimately decided—a sharp contrast with the 1.5 ºC limit proposed by AOSIS (Benwell, 2011). On the other hand, the Accord is often regarded as a landmark in adaptation funding for its establishment of the Green Climate Fund, pledges made by developed parties to contribute toward a final goal of USD 100 billion by 2020. Although designed to promote adaptive capacity within developing parties, the Fund is not only half the amount proposed by AOSIS, it is also available to *all* developing parties (Bishop & Payne, 2012; Benwell, 2011). Thus, its distribution overlooks needs for adaptation—the contextual vulnerabilities of developing parties are homogenized, and SIDS are thus marginalized.

For AOSIS, relative successes in procedure but failures in outcome consist an ongoing legacy. The Paris Climate Agreement (2016), both in its mitigation and adaptation targets, inherits this trend—the value-claiming needs of SIDS are left unsatisfied still. Reechoing the 2 ºC limit of the Copenhagen Accord, the Agreement's mitigation objective contrasts starkly with the

consistent 1.5 ºC proposal of AOSIS. Furthermore, it is doubtful that the individual countries' emission reduction pledges (INDC) can even allow for the targeted stabilization to be met; rather, it seems more likely that, through current commitments, global mean temperatures will stabilize around 2.7 ºC (Hoad, 2016: 317). As for adaptation funding, the Agreement can be considered a manifestation of progress: with a new pledge for USD 100 billion per year from developed parties, and regard given to 'the needs and priorities' of developing parties, the pledge demonstrates better, though unspecific, operationalization of contextual vulnerability (UNFCCC, 2015; Hoad, 2016). Still, like the Copenhagen Accord, the Agreement is non-binding; and the form funds are to take is undeclared (Hoad, 2016: 317). Were it to be reimbursable grants and loans, the improved access granted to SIDS would be undone, as it could only increase the existing debts of many SIDS (Hoad, 2016; López-Marrero & Wisner, 2012). Whether climate justice, a central concern to the Agreement, can be actualized by these outcomes, remains uncertain. However, mitigation targets seem designed for a future unsustainable to most SIDS; and, in spite of the advancements in adaptation funding, enforcement is required to ensure its just distribution throughout multiple scales (Barrett, 2012).

To distributional justice, contextual vulnerability is an inextricable concern; *understanding* the root causes of vulnerability is the first step in *addressing* it—the only effective means of fostering adaptive capacity (Adger, 2006; O'Brien *et al.*, 2007). In the following section, the Caribbean is selected as a regional case study; climate change will be assessed by its impact on regional livelihood, especially through national and local scale case studies of contextual vulnerability in Jamaican tourism and agriculture.

Contextual Vulnerability of Caribbean and Jamaican Livelihoods

The Caribbean exhibits a shifting economic landscape prevalent in other SIDS regions around the world: agriculture is making way for the rise of tourism (Nurse *et al*., 2014). As a region, the Caribbean economy is, in fact, the most tourism-intensive; the sector contributes to 14% of the regional gross domestic product (GDP) and over 50% in some nations (Scott *et al.*, 2012; López-Marrero & Wisner, 2012). Still, agriculture is economically significant, representing 10 to 35% of the regional GDP and 30% of the regional labor force (Pulwarty *et al.*, 2010). This economic transition manifests well in the Jamaican economy: whereas agriculture represents 7% of the nation's GDP and 20% of its labor force (CIA, 2016; Barker, 2012), tourism contributes 30% to the GDP and represents 35% of the labor force (CIA, 2016; William & Deslandes, 2008).

The crop yields of agriculture and the image of 'sun, sand, sea, and fun' central to tourism are both contingent upon climatic conditions; that is, both tourism and agriculture are *climate-sensitive* (Nurse *et al.*, 2014). Therefore, the economic centrality of these sectors contributes substantially to the social context for climate vulnerability in the Caribbean and Jamaica. In this section, the climate stresses and shocks to which these sectors are exposed and their historical and predicted losses are assessed in both regional and national scales. The analysis of contextual vulnerability is then localized; the relevance of tourism and agriculture to local livelihood is discussed, not only with regard to the impacts of climate change, but those of the global market as well. Through this multi-scalar analysis, it will become apparent that vulnerability is truly differential: variances geospatial distribution, geophysical composition, and in the socio-economic and political conditions of an exposure frame render it so.

Climate Change: Impacts to Tourism and Agriculture

Records indicate that air temperatures in the Caribbean have increased 0.6 ºC since the 1960s, as can be confirmed by an increase in warm days and warm nights and a decrease in cool days and cool nights (Taylor *et al*., 2012; Nurse *et al.*, 2014). By 2100, a 1.2 to 1.5 ºC rise from 1986 to 2006 averages is expected (Nurse *et al*., 2014). Warming increases rates of evapotranspiration, intensifying pre-existing water scarcity in many Caribbean nations. Both tourism and agriculture are major consumers of water. For Jamaican agriculture, this estimated increase in temperature will result in the doubling of current crop water deficits and significant losses in crop yields (Curtis *et al.*, 2014).

Regional rainfall patterns are not, however, entirely consistent with these drier conditions; that is, while alterations in the bi-modal 'dry-wet' seasonality of precipitation have been detected, with many nations predicted to experience longer dry periods and shorter wet periods, robust generalizations are difficult to construct (Taylor *et. al*., 2012; Barker, 2012; Nurse *et al.*, 2014). For example, whereas the PRECIS modeling of Taylor and colleagues (2013) suggests wetter conditions to be expected in the north and drier conditions in the south, the cartogram of López-Marrero and colleagues (2012: 34) presents contradictory rainfall records from 2008-2012. The latter also depicts differential rainfall patterns within both northern and southern sub-regions, attesting further to the challenges in constructively homogenizing precipitation patterns (López-Marrero *et al*., 2012).

Although national scale studies of precipitation in Jamaica are subject to differential distribution as well (Campbell *et al.*, 2011; Waite, 2012), in general, Jamaica is predicted to exhibit

overall drier conditions (Campbell *et al*., 2011; Barker, 2012; Popke *et al.*, 2016). As such, droughts present a significant threat to agricultural production, and are already perceived by local farmers as becoming longer and more intense (Campbell *et al.*, 2011; Popke *et al*., 2016). In the drought of 2008, for instance, Jamaica received 52% of their 30-year average rainfall, leading to a 50% loss of crops (Campbell *et al*., 2011). Farmers also note extreme rainfall events to be more intense and frequent—another observation consistent with national patterns (Campbell *et al*., 2011; Pulwarty *et al*., 2010). Therefore, notwithstanding the difficulty of distinguishing these trends from the historical climate variability of the region, it seems increasingly likely that, at the very least, weather conditions will become less predictable by the effects of climate change (Barker, 2012; Campbell *et al*, 2011; Popke *et al*., 2016).

Besides droughts and extreme rainfall events, another consequence of this increased variability is a rise in the frequency and intensity of hurricanes to affect the region (Pulwarty *et al*., 2011; Taylor *et al*., 2012; Nurse *et al.*, 2014). Spatial distribution is among the key contributors to hurricane exposure, as records indicate Greater Antilles to have experienced more hurricanes than the Lesser Antilles (López-Marrero & Wisner, 2012). Furthermore, in spite of the suppressing effects of three El Niño occurrences (1997, 2002, 2007), since 1995, hurricanes have become more frequent and more intense, with a rise in the number of category 4 and 5 systems (Taylor *et al*., 2012: 178; Pulwarty *et al*., 2010; ECLAC, 2011). Despite the inconclusiveness of predictions suggesting hurricanes to become increasingly frequent and intense, and the contestable attribution of these trends to climate change (Smith & Rhiney, 2016; ECLAC, 2011; Nurse *et al.*, 2014), hurricanes can cause significant losses in both tourism and agriculture in both the Caribbean and Jamaica. These extreme weather events impose threats to beaches and resort infrastructure (Hyman, 2013; ECLAC, 2011), and are capable of damaging crops and livelihoods (Barker, 2012; Campbell, 2011). The disproportionate vulnerability of the Jamaican economy is clear: in 2013, it lost 10% of its GDP to hurricanes. For comparison, storm losses, each year, only account for 1% of GDP in industrial nations (Hyman, 2013: 3).

In conjunction with the shocks of hurricanes, the stresses of ocean acidification and oceanic warming have contributed to dramatic increases in coral bleaching and mortality throughout the region (Pulwarty *et al*., 2010; Eakin *et al*., 2010; Nurse *et al*., 2014). Though no major bleaching events were reported prior 1983, since then 5,000 cases have been observed in the Caribbean (ECLAC, 2011). With these occurrences expected to become more frequent, Nurse and colleagues (2014: 1628) report that preserving more than 10% of coral reefs worldwide entails a 1.5 ºC limit to warming from pre-industrial levels, albeit regional predictions indicate a rise of 1 to 4 ºC from 1960 to 1990 mean temperatures by 2100. In addition to climate shocks and stresses,

coastal activity can also be attributed to the increase in bleaching and mortality; the damage to reefs and marine ecosystems by overfishing, artisanal fishing practices, as well as the pollution and land use changes from coastal tourism are frequently cited as stresses capable of inducing bleaching (Nurse *et al*., 2014; Pulwarty *et al*., 2010; Hogarth & Wójcik, 2015).

Coral is a key amenity to tourism not only for its fundamental role in marine ecosystems, but also for its function as a natural barrier to coastal erosion and, thus, its ability to preserve beaches (Rhiney, 2015; Nurse *et al.*, 2014). Its potential to retreat inland constrained by coastal development (*i.e.*, 'costal squeeze'), beaches are disappearing, especially under the stress of sea-level rise (SLR) and coastal inundation resulting from storm surges (Pulwarty *et al*., 2010; Scott *et al*., 2012; Cambers, 2009). Regionally, rates of SLR are generally consistent with the global mean of 1.8 mm yr^{-1}; with this rate expected to increase, sea-level is predicted to rise 0.5 to 0.6 m above 1986 to 2005 levels by 2100 (Nurse *et al*., 2014). A study by Cambers (2009) demonstrates erosion rates to have been approximately 0.5 m yr^{-1} between 1985 and 2000; and this rate is predicted to increase as well. A 50 to 100 m of erosion (following a 1 m increase in sea-levels) would result in losses to 49 to 60% for coastal resorts throughout the Caribbean (Scott *et al.*, 2012; Cambers, 2009). Rising sea-levels also induce saltwater intrusion, further intensifying water scarcity presently experienced in several Caribbean nations (Nurse *et al*, 2014; Cashman *et al.*, 2009). In Jamaica, where water scarcity is indeed a concern and 90% of its GDP owes to coastal activity (Hyman, 2013), a 2 m rise in sea-level is estimate to cause a 3% loss of agricultural land (Scott *et al*., 2012) and damage to 18% to major coastal resorts (ECLAC, 2011). Compared to the USD 1.934 billion generated by Jamaican tourism, for instance, a protective sea wall ranging in costs from USD 92.3 to 993.8 million does not seem feasible for the already debt-laden national economy (ECLAC, 2011; Barker, 2012).

With this complex of multiple, simultaneous climate stresses and shocks and their resultant economic losses to Caribbean and Jamaican tourism and agriculture discussed, the following two sub-sections will construct the context for climate vulnerability from a social dimension.

Globalization: Local Accounts of Double Exposure

Adaptive capacity and vulnerability are inextricable; the latter informs the former, and promoting the former may reduce the latter (Adger, 2006). As adaptation is mobilized on local scales, effective, just outcomes rely upon localized perspectives of vulnerability (Adger, 2001; Barrett, 2012). As policy is usually decided according to a Rawlsian interpretation of climate justice, only

upon identifying vulnerable groups and addressing their vulnerability can justice be considered actualized (Barrett, 2012). For such an enterprise, it is effective to enquire about the *root causes* of vulnerability—the geographically and socially engendered *context*—without which even the best intended solutions, such as adaptation funds and transfers of technology, are rendered ineffective and, in some cases, a cause for *greater* vulnerability (O'Brien *et al*., 2007; Kelly & Adger, 2000; Fisher, 2015). Having previously identified climate-sensitive sectors and the various climate impacts to which they are exposed, here the vulnerabilities of Jamaican tourism and agriculture are contextualized on local scales. Context is centered around human-environment relations, using a Double Exposure Framework, to examine how the pressures of and responses to climate change and globalization often interact with each other (Leichenko & O'Brien, 2008).

Tourism. In recent years, tourism has supplanted agriculture as the greatest earner of foreign exchange in Jamaica (Dodman, 2009). A burgeoning sector, tourism rapidly grows under liberalizing national policies and an influx of Foreign Direct Investments (Williams & Deslandes, 2008). It endows Jamaica a competitive advantage in the global and regional market, which agriculture, after the end of preferential trade with the European Union (EU), no longer retains (López-Marrero & Wisner, 2012; Barker, 2012; ECLAC, 2011; Williams & Deslandes, 2008).

Considering its economic significance, it is not surprising that tourism assumes a central role in Jamaican development (ECLAC, 2011; Hyman, 2013). Tourism, however, is a high-impact sector with externalities to be borne by the local environment and people (Pulwarty *et al*., 2010; Dodman, 2009; Cashman *et al.*, 2010). Falmouth and Montego Bay are two cities crucial to Jamaican tourism: the former is the largest contributor to cruise tourism in the nation, while the latter represented one-third of all stopovers made between 1993 and 2007 (ECLAC, 2011; Dodman, 2009). Dodman (2009) reveals that, despite their contributions to the sector, urban development is lacking in both cities. In other words, in response to growing tourism, the rate of urbanization has exceeded the rate of development—exemplified by issues of income, infrastructure, solid waste disposal, sanitation, and water accessibility common to residents of both cities. Instead, national development plans continue to divert resources toward the tourism sector, with the needs of the tourist as the first priority (Dodman, 2009: 213). Governance was often cited by the study's respondents to be the root cause for these socio-economic issues; and local responses have arisen accordingly, as non-governmental organizations and youth groups work to provide public services, information, and political solidarity to marginalized stakeholders (Dodman, 2009).

Dodman's (2009) study points to a noteworthy fact: top-down mobilizations of resources are often blind to local needs (Adger, 2001; Barrett, 2012). A consequence of the large inflows of foreign investments is the up-scaling of the top-down power structures operating Jamaican tourism: how the sector develops is increasingly overseen by distant, foreign powers unaware and detached from local socio-economic and political conditions. Partly owing to these investments, the growth of tourism has largely been concentrated upon coastal operations, further stimulating coastal development and augmenting the exposure of populations to the impacts of SLR and coastal inundation as a result (Hyman, 2013). Yet, a study by Hyman (2013) comparing coastal and inland tourism operations reveals the latter to be, ironically, more vulnerable: although some climate impacts, such as fires and vector-borne diseases, are arguably more relevant to inland operations, the greater access to emergency protocol and back-up water facilities renders coastal operations better able to cope when faced with common hazards, such as hurricanes.

Diversification appears as a means of reducing the overall vulnerability of Jamaican tourism (Hyman, 2013). However, the liberalization of the sector generates a power structure that expands coastal tourism and dictates local development; beyond increasing exposure to SLR and coastal inundation, the land use changes and pollution from coastal tourism operations threaten coral reefs, which are already stressed by warming and ocean acidification (Nurse *et al*., 2014). The inability to diversify continues to render local populations vulnerable to climate change. It deprives them of entitlements to resources and services, and suppresses their adaptive capacity (Kelly & Adger, 2000). Although some participatory groups have emerged as a response, their success in affecting management of the sector has been limited, and transformations of local, top-down power relations appear to be necessary nevertheless (Dodman, 2009; Adger, 2003; Pelling, 2011).

Agriculture. Since the World Trade Organization (WTO) decreed the end to preferential trade with the EU in the mid-1990s, agriculture has lost much of its competitive advantage in the global market (López-Marrero & Wisner, 2012; Barker, 2012). In response, mantras such as 'Eat what we grow, grow what we eat' and protectionist 'ring-fence' policies are indicative of the increasing centrality of agriculture to domestic food security (Campbell *et al*., 2011). However, with the drought of 1997 and the almost complete destruction of banana production from Hurricanes Ivan (2004), Dean (2007), and Gustav (2008) as being among major reasons for exporters to begin investing domestically, it is evident that such a response to globalization intensifies the exposure of national food security to climate change (Barker, 2012).

More than a means of subsistence, agriculture is culturally significant to many Jamaicans; practiced for generations, indigenous knowledge informs local scale production (Campbell *et al*., 2011; Barker, 2012; Popke *et al*., 2016). As Jamaican agriculture has historically endured the shocks and stresses of regional climate variability, alterations to climatic conditions are pertinent to this body of knowledge, and whether it has transformed in response can inform assessments of adaptive capacity (Campbell *et al*., 2011; Gamble *et al*., 2010; Popke *et al*., 2016).

Notwithstanding difficulties in producing a consistent national precipitation trend (Campbell *et al*., 2011; Waite, 2012; Curtis *et al*., 2014), a study by Gamble and colleagues (2010) indicates that the bi-modal pattern of annual precipitation is changing and that droughts are becoming more frequent in St. Elizabeth, a parish which contributes significantly to food security in Jamaica and its tourism sector (Campbell *et al*., 2011; Popke *et al*., 2016). 67% of the parish's surveyed farmers have detected changes in climatic conditions; of this group, 65% believe droughts to have become more frequent and intense, and 40% report the same trends for heavy rainfall events (Gamble *et al*., 2010; Campbell *et al.*, 2011).

For Jamaican farmers, the chronic nature of drought yields greater cumulative losses than the acute, wide-scale damage of a hurricane (Campbell *et al*., 2011; Popke *et al*., 2016). In response, recent national policies have sought to assist the sector by allocating resources toward the wider installation of irrigation systems and greenhouses. These are not, however, equally accessible to all farmers (Popke *et al.*, 2016). St. Elizabeth is replete with small farmers, who co-exist and compete with large scale farming operations (henceforth 'large farmers') (Campbell *et al*., 2011; Popke *et al*., 2016). Surveys conducted by Popke and colleagues (2016) reveal small farmers to be heavily marginalized in distribution, with large farmers usually reaping the benefits of these adaptation measures. The same can be said of water, the price of which sharply increases during droughts and has been steadily rising over the years (Campbell *et al.*, 2011).

Able to afford neither the installments of irrigation systems and greenhouses nor extra applications of water-retentive mulch (a common strategy employed in dry periods), small farmers have developed new practices against increasingly unpredictable weather. Despite some improvements in crop yields imparted by such adaptations, planting 'quick' and drought-tolerant crops, and scaling down production tend to yield vast supplies of the same crops and consequent gluts in local markets (Campell *et al*., 2011; Popke *et al*., 2016). The ones to thrive even under such market conditions are large farmers; having greater access to irrigation and water, these farmers can diversify cropping systems, which can be sold at higher prices (Popke *et al*., 2016). Greenhouses, on the other hand, have exhibited somewhat negative effects on local markets. Highly effective, greenhouses can produce a supply five to ten times greater than usual, also

entailing gluts in the market; nevertheless, drops in prices are likely to be more detrimental to the less economically-endowed small farmer (Popke *et al*., 2016).

Responses to climate change can generate winners and losers within markets. The adoption of less capital-intensive practices, like sharing water and adjusting times for planting, is a positive indicator of adaptation within an intrinsic store of social capital—the indigenous knowledge which has informed Jamaican agriculture since generations past (Campbell *et al*., 2011; Barker, 2012; Popke *et al*., 2016; Adger, 2003). Yet, in being marginalized from entitlements to physical capital and resources, the capacity to adapt is severely limited, and it is doubtful that these examples of social capital alone can relieve small farmers their vulnerabilities (Campbell *et al*., 2011; Popke *et al*., 2016; Adger, 2003). Considering this, Popke and colleagues (2016: 78) express appropriate suspicion: is the modernization and sophistication of agriculture and its technologies truly sufficient to address vulnerability? With most farmers blaming the unsustainability of the sector on the lack of affordable and organized aid from the national government, it appears not: as far as entitlements are differential, so too is adaptive capacity (Kelly & Adger, 2000). And so, once again, transformations in governance appear as a dire necessity to climate justice (Popke *et al*., 2016: 79; Pelling, 2011).

Conclusion

Vulnerability is already a term widely operationalized in policy-making, namely as a proxy for the worst off in a Rawlsian framework of climate justice. This suggests that inequality is a relevant concern to the procedures and outcomes of policy, testified by the principle of 'common but differentiated responsibilities' of the UNFCCC (1992: Article 3(1)). Interpretations of vulnerability are numerous, however; and the conceptual framework implemented presents real consequences to the outcomes of policy (O'Brien *et al*., 2004; Adger, 2006). The literature currently informing policy is often dense in scientific research primarily fixed upon the biophysical dimension of climate change (O'Brien *et al*., 2007). Policy is, thus, often designed to ameliorate impacts irrespective of the socio-economic and political context upon which adaptive capacity is contingent (Kelman, 2014; O'Brien *et al*., 2007). Owing to this, funds and transfers of technology are at times rendered into topical solutions, whose successes may be few and easily undone in certain contexts (O'Brien *et al*., 2007).

Climate policy may be conceived as a top-down process, often commenced from the global scale and resulting in modifications apparent in local scales; likewise, climate justice

necessitates a multi-scalar framework—one which considers both differential vulnerability and the context which begets it (Barrett, 2012; Fisher, 2015; O'Brien *et al*., 2007).

SIDS are widely regarded as being comprised of some of the most vulnerable regions in the world (Nurse *et al*., 2014; UNFCCC, 2015; Hoad, 2016). Underlying the variances in geographic and social context are the common traits of smallness and remoteness, both of which, though geographic, present economic limits to the adaptive capacity of SIDS (Briguglio, 1995; Pelling & Uitto, 2001; Benwell, 2011). Scarce in resources and social capital, and geographically pre-disposed to natural hazards, SIDS are externally dependent upon the global market and global scale climate policy-making (Briguglio, 1995; Pelling & Uitto, 2001; Bishop & Payne, 2012).

By these similarities in contextual vulnerability, forty-four SIDS are represented in global policy negotiations by AOSIS (Benwell, 2011; Betzold, 2010). For this group, the disproportionate vulnerability of its constituents and their negligible greenhouse gas emissions comprise the normative approach it takes in negotiations. Successes are mixed, however. Though the drafting of the UNFCCC and the wider identification of SIDS as being among the most climate vulnerable indicate successes in shaping procedures, AOSIS is still lacking in outcome achievements—the mitigation and adaptation objectives which are deemed necessary for sustainable development in SIDS. Moreover, the recent Paris Climate Agreement (2015) suggests that this trend continues (Hoad, 2016). Since the context and degree of vulnerability is not common among other negotiating parties, AOSIS is forced to take an ambitious position with interests often marginalized in discussions centered about economic efficiency (Byrne & Inniss, 2002; Bishop & Payne, 2012; Benwell, 2011). Hence, the 'victim status' of SIDS is a double-edged sword—encouraging urgency within negotiations on the one hand, albeit constraining political prowess on the other (Betzold, 2010; Benwell, 2011).

Like other SIDS regions, the Caribbean is particularly vulnerable to climate change due to its heavy reliance on the climate-sensitive means of economic production: namely, tourism and agriculture (Nurse *et al*., 2014). As both sectors tie Caribbean nations to the global market, the effects of globalization are relevant to depicting contextual vulnerability (Barker, 2012; Pelling & Uitto, 2001). Thus, the multi-sector assessment of this work incorporated the Double Exposure Framework, through which climate change and globalization were considered as affecting exposure frames simultaneously and, in many cases, synergistically (Leichenko & O'Brien, 2008).

For a meaningful study of adaptive capacity in tourism and agriculture, the scale of the analysis was reduced, focusing on Jamaica as a case study to depict national and local scale vulnerability. While Jamaica may not be representative of all SIDS within the Caribbean (much less all SIDS around the world), its economic landscape, which currently shifts towards a more

tourism-intensive economy, may have relevance to the contextual vulnerability of SIDS which exhibit a similar trend. With the former competitive advantage of Jamaican agriculture rendered dull by the WTO, tourism has achieved dominance over the national economy (López-Marrero & Wisner, 2012; Barker, 2012). Its growth, however, lies largely in the hands of foreign investors distant from local issues, especially as policies further liberalize the sector (William & Deslandes, 2008). Yet, as a high-impact and profitable sector, Jamaican tourism consumes a disproportionate amount of limited resources, because of which development in cities critical to tourism is often lacking. The entitlements to reliable infrastructure, waste disposal facilities, and clean water are among the basic services that are denied to residents, as the needs of tourists take precedence in development agenda (Dodman, 2009). Furthermore, this one-sided allocation of resources nullifies the potential to diversify the sector. Inland tourism operations are, for instance, demonstrated by Hyman (2013) to be more vulnerable than coastal operations to common hazards, namely due to being deprived of comparable coping mechanisms (*e.g.*, back-up water facilities, emergency protocol, *etc.*). Foreign investments continue to tug Jamaican tourism toward the coasts with populations to follow. Thus, the cry for equity from residents is not only neglected, but amplified by the climate impacts (*e.g.*, SLR, coastal inundation) to which they are further exposed (Hyman, 2013; ECLAC, 2011; Nurse *et al*., 2014).

Jamaican agriculture, having lost much of its relevance in the global market, has adopted a more domestic role as a provider of national food security (Campbell *et al*., 2011; Barker, 2012). Existing indigenous knowledge, a form of social capital valuable to the sector, has demonstrated recognition of recent alterations in the national climate (*e.g.*, more frequent hurricanes and heavy rainfall events, and longer, more intense droughts); and farming practices have accordingly adapted to these changes, albeit with limited success (Gamble *et al*., 2010; Campbell *et al.*, 2011). The response of the national government has been, namely, to promote the installation of irrigation systems and greenhouse gases. However, farmers in St. Elizabeth assert that entitlements to these resources are not equally distributed (Campbell *et al*., 2011; Popke *et al*., 2016). In most cases, small farmers are marginalized in these adaptation measures, while relatively affluent farmers solely reap benefits. This lack of access renders small farmers disadvantaged in the market, with large farmers exploiting price spikes during droughts. With many farmers commenting on limited government support, it is evident that adaptation measures made in abstraction of local social context not only fail in resolving issues of climate justice, but may foment them as well.

As the examination of this work revealed, the context for vulnerability is differentiated by scale and sector; and without proper consideration of context, policy is often bound to intensify

vulnerability by fomenting the existing conditions for structural inequality (O'Brien *et al*., 2007; Adger, 2001; Fisher, 2015). This study calls for a re-evaluation of the current operationalization of vulnerability in policy, suggesting that addressing the geographic and social induced root causes is integral to the application of effective and just adaptation measures. Consistent with Barrett (2012), the achievement of climate justice is a multi-scalar enterprise; for though local scale communities may have intrinsic abilities to cope, the capacity to adapt and foster resilience in the face of climate change often render them reliant upon larger scales of governance (Adger, 2001). Hence, structural inequality is sufficient evidence for the necessity to transform *structures*—the existing, multi-scalar structures of power that, when left untouched, perpetually impede the actualization of justice (Pelling, 2011).

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