Human Vulnerability to Climate Change

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It seems somewhat of a paradox, to suggest catastrophic and irreparable damage to humans and natural systems from global environmental changes need not result in catastrophic and irreparable damage to humans, although catastrophic and irreparable damage to humans arise from even modest changes in natural systems (Heltberg et al., 2009). Minimizing human vulnerability to environmental changes is largely determined by the extent to which groups of humans (societies) can develop and organize themselves, to render themselves susceptible or resilient to changes, which refers to the extent to which societies can manage the impacts from hazardous events or disturbance trends in social, economic and environmental systems (Lahsen et al., 2010; IPCC, 2014 :40). Whilst literature on the impact, adaptation and vulnerability (IAV) to humans from environmental changes has increased two-fold between 2005 and 2010, to 234,823 publications worldwide, the geographical diversity of authorship is limited (IPCC, 2014 :38). Since 1980, only five percent of IAV publications were published in Africa and Latin America, an area which is often said to be "especially exposed and vulnerable" to the impacts of environmental changes (Lahsen et al., 2010). Geographic-specific research on IAV issues allows policymakers to enhance societal measures on resilience, which aim to reduce human vulnerability to environmental changes, however, countries in this region have either been less willing or unable to conduct such research comparable to other regions. Environmental vulnerability is commonly defined as the extent to which humans, and the things they value, are *exposed* to environmental changes, are *sensitive* to this exposure, and the degree to which they can *adapt* to these changes, in which, various studies have found vulnerability in Latin America, Africa and parts of Asia are increasing (IPCC, 2014 :39; Eckstein et al., 2018; Mucke, 2017). It is thus apparent that climate-resilience is conditional, based on economic resources, geographic exposure and political will, in which this essay explores the extent to which these barriers to resilience are increasing human vulnerability to climate changes and whether Costa Rica's ecocentric approach to governance can influence resilience beyond its borders (Held et al., 2017).

Although environmental concerns comprise a broad range of environmental issues, IAV literature is most concerned with environmental changes caused by global climatic change (Lahsen et al., 2010). Climate change is an anthropogenic phenomenon, whereby an increase in carbon emissions – as a byproduct of human activity in the industrial era – is causing global atmospheric temperatures to rise under the natural 'greenhouse effect', driving unprecedented environmental changes and subsequent IAV issues (IPCC, 2018). The invisibility of the phenomenon requires compelling scientific evidence to clarify its existence, severity and threat to human life. Since 1988, the Intergovernmental Panel on Climate Change (IPCC) has played a global role in solidifying a global scientific census on climate change and its impacts. In the IPCC's (2018) Summary for policymakers, a series of clear statements were presented with high confidence. That, overconsumption and rapid population growth has driven anthropogenic emissions to "1°C of warming above pre-industrial times", which is likely to cause "long-term changes in the climate system", and "climate-related risks for natural and human systems [at 1.5°C of warming] are higher than at present". Given that Cook et al (2016) identifies 97 percent of all peer-reviewed scientific publications agree that climate change is caused by anthropogenic activity, and the latest IPCC (2018) report was written by over 133 authors, from 40 countries, and includes over 6000 referenced citations, the scientific evidence becomes undeniable.

Climate scientists have observed global climatic change to increase the frequency and intensity of geophysical, hydrological, meteorological, climatological and biological events, which include: landslides, extreme weather events, flooding, drought, wildfires and disease epidemics (such as the spread of water-borne diseases) (IPCC, 2018; CRED, 2009). These climate changes can often lead to significant changes in the economic and social environment,

including commodity-based price volatility, resource scarcity, conflict escalation and increased climate migration (Heltberg et al., 2009). For example, a 26 percent increase in oceanic acidification (above preindustrial times), has contributed to a 23 percent increase in coral bleaching between 1980 and 2016, which has devastated marine ecosystems worldwide, as Richardson et al (2018) found fish variations amongst bleached coral communities were "almost entirely lost" (IPCC, 2014; Dunne, 2018). Tim McClanahan, a fisheries zoologist, found this to be the case in south-eastern Kenya, where communities have become rapidly vulnerable to the lack of fish since 1998, as both a source of food and income (Morello, 2012). In 2014, Kenya became the eighth highest country for conflict-related and natural hazard-related migration, mainly due to conflict escalations over fish stocks, water and land disputes (IMDC, 2015). Conflict can exacerbate human vulnerabilities, as the turmoil conditions of war can increase resource scarcity, spread disease and destroy civilian livelihoods, in already environmentally stretched and challenged regions. Whilst theorists like Peter Gleick (1993 :79), *inter alios*, popularized the idea that water will become an increasingly salient element in interstate politics, inciting violent conflict, it is becoming increasingly more evident that climate migration, due to climate events and war, will become an integral part of the international system. The World Bank estimates climate migration will reach 143 million climate refugees by 2050, some 430.3 percent above the 2015 level which could increase human vulnerabilities to regions beyond the conflict zone (Rigaud et al., 2018; IMDC, 2015).

Maximizing Resilience

In order to analyze whether human vulnerability is increasing, one may view vulnerability and resilience as two sides of the same coin, as vulnerability exists in the absence of resilience and vice-versa. Maximizing resilience requires large investments in IAV research, climate-resilient infrastructure and technologies, in which, IAV literature overwhelmingly suggests developing countries are particularly at risk to climate changes, due to their lack of financial resources, as they rely on climate sensitive sectors and low incomes (Heltberg et al., 2009). For example, the global climate risk Index (CRI) found; Puerto Rico, Honduras, Myanmar, Haiti, Philippines, Nicaragua, Bangladesh, Pakistan, Vietnam and Dominica, as of the 10 most at risk countries to climate changes between 1998 and 2018 (Eckstein et al., 2018). Of these countries nine are considered "developing economies" by the United Nations (UN) and have a Gross Domestic Product (GDP) per capita well below the global average, which weakens their economic propensity to maximize resilience (Puerto Rico was unclassified due to insufficient data) (Eckstein et al., 2018; WESP, 2019 :170; World Bank, 2019).

Micale et al. (2018) identifies there is a large adaptation gap for adaptation and mitigation (resilience) measures amongst developing countries. Although developing countries have committed to mobilizing 100 billion USD per annum for resilience measures, the UN (UNEP, 2018) indicate they will require between 140 to 300 billion USD per annum by 2030 in order to adapt to a 1.5°C to 2°C future, an annual shortfall of 40 to 200 billion USD per year – some nine-to-nineteen times above the current adaptation finance. Due to this, human vulnerability becomes a staple aspect of the 'gap' between adaptation finance and the required amount of adaptation measures, which could be higher in some areas than others, as one cannot assume the current adaptation fund will be spent proportionately. Although the UN (WESP, 2019) observes "robust" global economic growth between 2016 and 2019, of 3 percent GDP, climate events are increasing long-term economic turbulence in commodity-based economies, and thus, the economic realities of developing economies are hidden. As both the IPCC (2018) and UN (UNEP, 2018) suggest more adaptation measures will be required under future temperature scenarios, human vulnerability is likely to increase in line with the adaptation gap, if additional funding is not mobilized.

Perhaps the most significant short-term outcome of the adaptation gap is that adaptation capital may rapidly become insufficient, as the research, infrastructure and technologies become increasingly inefficient to deal with the growing frequency and intensity of climate events. This can be observed in south-eastern Africa today, as, Cyclone Idai battered Mozambique and other parts of south-eastern Africa on 14 March, 2019, killing 700 people and affecting 1.8 million people thus far (BBC, 2019). Prior to Cyclone Idai, the Mozambique Costal Cities and Adaptation Programme (CCAP), implemented in 2014, focused on introducing a mobile phone alert system and low-cost flood resistant housing, in increasing resilience towards flooding (ECODIT, 2017). However, many would argue these adaptation measures were wildly insufficient to meet the demands of the Cyclone Idai, which is said to be one of the worst meteorological events to hit Mozambique to date (BBC, 2019). Also, adaptation capital and its gains, like telephone poles and flood resistant housing, have been destroyed, which widens the adaptation gap and can keep societies

and their governments in a constant state of poverty, as societies are reluctant to accumulate capital under the volatility of climate events and governments grow evermore indebted to their creditors (Lahsen et al., 2010; ECODIT, 2017).

The second barrier in achieving resilience is founded upon the extent to which developing countries are geographically exposed to climate changes. Although globally, warming is reported to be approximately 1°C above preindustrial times, warming is greater than the global average over land regions than ocean (IPCC, 2018 :6). Bathiany et al (2018) identified hotspot zones within land regions where temperature variability is greatest and is thus where the severest environmental impacts are predicted. Their results concluded temperature hotspots, above the mean global temperature, where overwhelmingly located in the Tropics region, where both the CRI (Eckstein et al., 2018) and World Risk Report (WRR) (Mucke, 2017: 17) found the most at risk countries to climate changes using different metrics techniques. On this basis, it is possible to suggest geographic exposure is a significant factor in increasing human vulnerability to climate changes and as geographic location of land regions are static, exposure is unavoidable. Considering 91.5 percent of the 47 least developed countries are situated in the tropics, the region already suffers from a weak adaptive capacity (Harding et al., 2017 :13; WESP, 2019). By 2050, the tropics is expected to house 50 percent of the world's population, exposing approximately 68.4 percent more humans to climate changes compared to today's level, with the highest population growth rate expected in Africa (Harding et al., 2017). Neo-malthusians, like Paul Elrlich (1968), suggest population growth will at some point overcome food production, which will lead to famine and catastrophic events, like violent conflict. Whilst both intrastate and interstate conflicts over resources can be observed in recent times, in Kenya for example, and the Nile basin, Elrlich's hypothesis demonstrates a degree of credibility, further suggesting human vulnerability can only increase.

Lastly, maximizing societal resilience is a question of political will, as those who govern can choose to adopt a mandate to increase climate resilience, or not. Held et al (2017) suggests there is little domestic ownership over climate considerations in developing countries, as most developing states are neither prepared nor interested in introducing climate polices, and what limited polices do exist are often a product of multilateral and transnational actors from industrialized states. In 1997 Costa Rica became the only developing country in the tropics to commit to reducing human emission through a Pigouvian carbon tax, although now, Mexico, Colombia and Chile have introduced a similar tax since 2012, which covers just 4.8 percent of all developing countries in the tropics (World Bank, 2016). Klein (2014: 11-15) suggests the most robust, universal, display of a lack of political will towards climate-resilience amongst developing states, was seen at the 2009 Copenhagen Accord, which led to the failure to achieve a legally binding deal, as developing countries highlighted their socio-economic differences against the global north, and thus their financial inability to commit to a global climate-resilience strategy. This attitude continues to persist, as the 2018 Climate Change Adaptation Conference in South Africa concluded that there had not been enough adaptation legislation at the domestic level in Africa to increase continental resilience, nor has the African Union (AU) adopted a substantive regional framework on cross-border resilience measures, despite recognizing resilience as "imperative" (Petrik and Ashburner, 2018).

The realist perspective best describes the lack of climate governance across developing countries. Realists would suggest military and economic issues dominate the political agenda, otherwise known as areas of 'high politics', which are necessary to secure and maximize state survival under the international condition of anarchy (Hough, 2015 :215). Under this assumption, ecological concerns become peripheral issues and cannot be addressed until a country has achieved a certain level of military and economic security, a level which is yet to be achieved in most developing countries, which seeks to explain the lack of interest in climate-resilience. As well as the realist explanation, some academics have observed corruption to weaken the political capacity of developing states to deal with 'peripheral' concerns. Transparency International (TI) (2018) found that Sub Saharan Africa was the lowest scoring region for transparency, scoring 32 out of 100 points. The countries identified as most at risk to climate changes by the CRI (Eckstein et al., 2018), scored an average of 29 points, 3 points below the lowest scoring region, and thus it is possible to suggest the most vulnerable countries to climate changes are likely to suffer from high levels of corruption. TI (2018) also found a link between authoritarianism and corruption, as the more authoritarian a country is the more likely high levels of corruption are present. As both Freedom House (Abramowitz, M., 2018) and the Economist Intelligence Unit (2018) have identified a global regression in democracy since 2006, including the United States (US), the global political spectrum is somewhat accepting, normalizing and embracing a regression to

state-centric politics, which could further marginalize environmental concerns if corruption levels where to increase in tandem, which could see an increase environmental vulnerability (Dodds and Pippard, 2005 :199).

The Costa Rican Model

Whilst themes in IAV literature overwhelmingly suggest humans in developing countries are becoming increasingly more vulnerable to climate changes than ever before, Costa Rica presents as an anomaly. Despite being classified as 'developing' by the UN (WESP, 2019), and situated in one of the most geographically exposed areas in the tropics, Costa Rica has maximized political will to increase climate resilience, so-much-so that it pledges to become carbon neutral by 2021, some 29 years before the EU (Held and Roger, 2017; Europa, 2019). According to the WRR (Mucke, 2017 :42), Costa Rica has an exceptionally low 'lack of adaptation rate' relative to its neighbors at 34.55 percent, a score more comparable to European countries like the UK, Lithuania and Portugal, at 29.95, 34.45 and 34.13 percent. Whilst a degree of climate exposure is unavoidable, due to economic and geographic factors, Costa Rican's are relatively more insulated from the effects of climate changes than most other developing countries in the Tropics owed to good climate governance.

Many would argue that the defining factor of Costa Rica's success in climate-resilience is largely attributed to its strong legal and constitutional basis. Article 50 of the 1949 Costa Rican constitution states, "every person has the right to a healthy and ecologically balanced environment, being therefore entitled to denounce any acts that may infringe said right and to claim redress for the damage caused" (National Constitutional Assembly, 1949). Ecological commitments thus go beyond the realm of party politics but have become a staple aspect of Costa Rican culture, as if ecological rights are inalienable rights of citizenship. This basis gives climate-resilience a strong political framework and sustains the direction of climate policies over time. Evidence of this success can be seen in the 2007 National Climate Change Strategy, which identified the energy sector as a "priority sector for intervention", leading to Costa Rica supporting itself on renewable energy for 299 days in 2015, 271 days in 2016 and 300 days in 2017, a global record (NAMA, 2019; Lutkin, 2017). Perhaps what is more impressive is Costa Rica's "Programa País", the private-public cooperation project, which creates market incentives for carbon-neutrality in the private sector. For example, in 2012, Coopedota – a private coffee producing company, was the first coffee producer in the world to achieve carbon neutrality at every stage of the production process (Voinea, 2012). Philippe le Houerou (2016) argues reforming a governments role in climate governance is key to unlocking climate-smart private investments in improving resilience in developing countries across the tropics. If other developing countries were to simulate similar conditions to Costa Rica, he suggests, there is 23 trillion (USD) for smart-climate investments from the private sector in developing countries between 2016 and 2030, some 164 to 76 times more than the UNEP (2018) estimates for required adaptation finance until 2030. Whilst the private sector is important, Costa Rica proves good climate governance is multifaceted, drawing upon strong government policies, a sound legal basis, private-public cooperation and civil society. As the US continues to retreat from its global governance role, Costa Rica may offer a 'soft' green leadership role for those countries who are struggling to increase climate-resilience, at a time where frequency and intensity of climate changes are increasingly becoming unavoidable (Dodds and Pippard, 2005).

On the contrary, some may argue Costa Rica's green success is not generalizable. With no real military threats to its national security, ecological welfare is able to enter the political mainstream, which is perhaps inconceivable in conflict zones (Held et al., 2017). However, recent adaptation advancements in Mexico seem to follow Costa Rica's green revolution. As well as enacting a carbon tax in 2013, Mexico passed constitutional-level energy reforms in both its oil, gas and electricity sectors, in 2014 and 2015, which makes the production of energy from clean sources obligatory and facilitates increased investment in clean and renewable technologies (Perez et al., 2016). Considering Mexico is experiencing unprecedented levels of rampant violence (Abramowitz, 2018), Mexico's environmental advancements demonstrate the possibility of replicating the Costa Rican model, even if reforms are in their infancy. Although Costa Rica and Mexico's differences are likely to impede on the success of Mexico's green reforms, as Mexico is 28 percent more corrupt than Costa Rica (TI, 2018) and less democratic by operating a 'party-free' rather than 'free' democratic system (Abramowitz, 2018), Mexico nonetheless proves that advancing green policies are possible in challenging circumstances.

Conclusion

As the IPCC (2018) predicts climate-related risks will increase as the temperature increases and current emission scenarios expect global warming to reach 1.5°C by 2030 to 2052. It is possible to conclude (with high confidence) that humans will become increasingly more vulnerable to climate changes than ever before, without any additional climate-resilient measures, across developing countries in the Tropics. If adaptation finance does not increase to meet the growing demand for climate-resilience and population increases continue at the current rate, more people than ever before will be exposed to climate changes, thus widening the physical, economic and social vulnerabilities of climate changes. However, the paradox that catastrophic and irreparable damage need not occur to humans, is founded upon the successes of the 'Costa Rican model', which proves maximizing political will through a legal and market-based approach can effectively increase climate-resilience and alleviate human vulnerability. Although many would question the transferability of Costa Rica's success, Mexico's recent Costa-Rican style approach to climate-resilience suggests there is a possibility to implement some green reforms in sub-optimal conditions. As the need to close the adaptation gap becomes increasingly unavoidable under higher temperature scenarios, the Costa Rican model could become relatively more attractive under growing climate stresses, which could suggest humans may become increasingly more resilient to climate changes than ever before in the long-term future, which is likely to be the subject of future IAV research.

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