

# The Human Dimensions of Coastal Adaptation Strategies

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**Abstract:** Not only are humans responsible for the anthropogenic causes of currently observed climate change, but we are also responsible for our responses to climate change. How we choose to respond provides important insights into our ability to collectively act in the face of threats with the unique characteristics of climate change. This communication attempts to provide an overview of some of the difficulties in forging new policy directions along our coastlines in an era of climate change. It is meant as a referential framing for the research presented in this Special Issue. As this communication is being written, the world is gripped by a global pandemic caused by a variant of the coronavirus. There are important corollaries between the underlying characteristics of the coronavirus and the causes and effects of climate change. Seeing how the global citizenry is responding to the current epidemic provides some insight into the difficulties in fostering collective action towards climate change. As with the pandemic, the issue is not really one of understanding the problem, but rather the varying human responses to the problem. We can expect the same difficulties as we continue to confront the ever-growing problem of climate change.

**Keywords:** climate change; coastal adaptation; collective action



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## 1. Introduction

There is no objective controversy on the existence of climate change. By now, it is one of the most well-studied and proven global phenomena of our time [1]. Not only has climate change been shown to be occurring throughout the globe based on thousands of peer-reviewed scientific studies, but the main cause has also been proven beyond all reasonable doubt: the human movement of carbon from stored sources, mainly buried below the earth's surface, into the atmosphere. While there is no objective basis for controversy about the existence of climate change or human accountability as a cause, there is a great deal of controversy among humans about what actions to take in response to climate change [2]. This is especially true in coastal areas around the globe. Coastlines represent areas disproportionately favored by humans, as evidenced by a multitude of major coastal port cities globally [3] (pp. 3–19).

Coastlines, and low-lying coastal cities in particular, are epicenters for the immediate and long-term impacts of climate change, yet many of these areas are not proactively planning for climate change [4,5]. There are many reasons for this, which generally center around a mixture of how humans make decisions in light of imperfect information and how that results in changing existing behavioral patterns and altering current expectations [6]. At the heart of this collective action problem are the very characteristics of climate change and how those characteristics make it difficult to develop wide-ranging and proactive changes to human behavior.

The purpose of this communication is to introduce the reader to some of the unique characteristics of climate change in general, and coastal climate change in particular, showing how those characteristics make it difficult to apply proactive policy solutions that differ from past decisions. Because climate change shares many of the same characteristics as the current coronavirus pandemic, the global policy response to the pandemic—focusing on the diversity of human responses and policy approaches—will be used to highlight

how the human dimensions impact proactive policy development. Beyond identifying the barriers inherent in developing proactive coastal adaptation strategies in light of human dynamics, some general solutions will be overviewed. The goal is to help frame the larger policy context in which research on the human dimensions of coastal climate adaptation strategies takes place. By understanding these contextual framing dynamics, it is hoped that the science that provides the evidentiary basis for action on climate change can be complimented with more rigorous and meaningful policy development.

## **2. Externalities: Individually Rational Choices Leading to Collectively Irrational Results**

Any epidemic, like the current coronavirus, presents unique challenges for human decision-making, which begins at the individual level and aggregates to influence public policy-making at the level of government. One of those challenges is getting individuals to change their behavior for the collective good. Often the bargain is unequal, meaning from the personal perspective the perceived cost to the individual of changing their behavior exceeds the benefits [7]. For example, a young person who is otherwise healthy might see the risk of getting infected as low, whether “risk” is defined as actually getting infected or as the impact of infection. When they balance this perceived risk against government mandated restrictions, they might see the restrictions as overburdensome; since they weigh the individual risk as low, even small disruptions to personal choice and daily behaviors are considered too costly, and that is true whether the restriction is attached to preventing activities such as going to bars and nightclubs, or the less inconvenient activity of social distancing.

The same can be said of climate change. Many individuals see government plans to lower carbon emissions as an attack on individual freedoms. This may be most apparent in proposals to place a price on climate change through carbon taxation [8]. In the United States, an early attempt in the 1990s to enact such a tax at the national level was met with strong public resistance, even when the nominal cost was low. Economists call this kind of phenomenon nominal rigidity, sometimes referred to as price-stickiness or wage-stickiness [9]. The basic concept is that a nominal price (what we are paid for our labors or what we pay for goods and services) is resistant to change. The best example may be wages. Even when there is a recession, and the prices of goods and services are declining, people are highly reluctant to accept reductions in how much they are paid for the same job. This is the case even when, due to recessionary pressures, their purchasing power is increasing (i.e., they can buy more with less money). It is rational for an individual to expect their wages not to decrease for the same job over time, but this expectation can lead to distortions where wages are out-of-line with market conditions, which can ultimately lead to externalities in the larger economy. John Maynard Keynes described an early example of nominal rigidity as a leading precursor to the Great Depression in the United States [10].

Distortions, like price- and wage-stickiness, happen because humans have expectations that misalign with a larger reality. At the heart of this misalignment is a distinction between the individual and the collective good. Major collective problems, like the coronavirus pandemic and climate change, share common characteristics that misalign individual and collective incentives. Climate change, for example, is sometimes referred to as a super-wicked problem [6] because the costs of climate change aggregate over time and do not accrue to the individual actions that, collectively, create the aggregate problem. Like the young person discounting the risks of coronavirus described above, individuals can engage in actions that add up to increasing the risks and effects of climate change in the future while not incurring any of that future cost today (and meanwhile enjoying the benefits of their climate change-inducing activity). There are numerous examples of this kind of free riding behavior. Many public health issues, such as smoking, are based on individual behaviors that accept a small cost today in exchange for the benefit of the activity, putting off the possibility of the cost incrementally accruing at some point in the future, e.g., a young person getting lung cancer at a later age. Even this example is imperfect because the act of smoking can at least be conclusively shown to increase the risk

to the very person who smokes. Driving an inefficient automobile, traveling by plane, or engaging in similar carbon-intensive activities does not increase the future risk of climate change to that individual—at least not directly. Even coronavirus can infect the young person discounting the risk, so the potential is real. However, climate change can present the future threat as something very distant from the individual, making freeriding choices more likely. This is why climate change is seen as such a difficult, or super-wicked, problem from a public policy vantagepoint.

### 3. Coastal Adaptation: Developing Policy Nobody Wants but Everyone Needs

Meaningful coastal adaptation policy to climate change requires viewing coastlines in a fundamentally different way than we presently do. Consider that, currently, there are over 3 billion humans living within 60 km of coastlines worldwide [4]. Eighteen of the largest twenty-five cities globally are located on a coastline with a cumulative population of over 350 million residents, or approximately 5 percent of the world's total population [3] (pp. 3–19). These are major international destinations such as Tokyo, New York City, Shanghai, Mumbai, Buenos Aires, Manila, Lagos, Istanbul, and Jakarta to name a few. The United States itself can be considered mainly a coastal nation, with over 50 percent of the US population living within a coastal county, an area that takes up less than 20 percent of the continental US land area. In terms of density, US coastal counties average 446 persons per square mile, over four times as high as the national density of 105 persons per square mile [11]. It is clear, for numerous reasons, that coastal areas in the US, and globally, have become preferred regions for humans to live.

While coastal regions are seen as desirable areas by humans, the realities of climate change are increasing the objective risks of living in these regions. The Intergovernmental Panel on Climate Change (IPCC) has produced the most comprehensive and authoritative assessments of climate change impacts, both observed and predicted, over the past thirty-plus years [1]. Both the most recent Fifth Assessment and the soon-to-be-released Sixth Assessment (2021–2022) reaffirm the previous assessment's findings and predictions that climate change is occurring at a quickened pace on a global level with disproportionate impacts being felt in coastal areas [12]. In the United States, this finding has been affirmed and expanded upon by the United States Global Research Program's most recent Fourth National Climate Assessment [11]. This assessment indicates that coastal environments in the US are at-risk, experiencing increased frequency and intensity of coastal precipitation, storm surges, and erosion. It lays out a scenario for coastal property owners and municipalities, noting repeat property losses should, over time, lead to diminished demand for coastal property. This, in-turn, should lead to cascading economic effects for coastal communities and local municipalities that rely on funding mechanisms such as property tax revenues tied to coastal property valuations. To provide some sense of economic impact, the Organization for Economic Cooperation and Development (OECD) has calculated that 25 million people and over \$2.2 trillion (USD) in assets are currently at risk in twenty global port cities due to observed climate change. They project that number to increase to over 88 million people and \$27 trillion (USD) in assets by 2070 [4] (pp. 22–26).

Based on recent analyses done by organizations like the OECD and others [13], it is obvious that climate change is causing increased risks to coastal living. As climate change itself is an aggregate process, so too are the risks; they accumulate over time, such that inaction today does not lead to immediate and proportional consequences that are felt today. In the same vein, enacting new policies today that attempt to proactively deal with the climate risks of tomorrow can exact costs today without generating immediate benefits. Nations currently struggle with this duplicity of policy choice in their attempts to proactively respond to a similar aggregate risk: the coronavirus pandemic. There is clear need to develop proactive policies to prevent the worst-case scenarios of virus spread without massive vaccine distribution and uptake. Fundamentally, when new policies ask people to limit and/or alter their current activities and behaviors, public pushback has centered around notions of personal freedom and choice. In effect, for some, the costs of

the policies exceed their perception of immediate benefits, mainly because they cannot see the aggregate future benefits of lower transmission rates, increased hospital capacity, and lowered death rates. When proactive policies operate effectively, they prevent worst-case scenarios of aggregate policy problems like coronavirus and climate change from occurring. The downside to this is that it is hard to prove the benefits of avoiding a worst-case scenario when that worst-case scenario is avoided—or when it never occurs.

Effective proactive policies work best when they prevent the aggregate negative outcome from happening, like massive human suffering of an unchecked virus or the worst-case scenarios for a warming planet. Proactive climate change policy seeks to limit carbon emissions to prevent the Earth's ultimate warming, not from warming that will occur tomorrow or next year. Those policies are not easily rewarded by the public. If proactive policies limit deaths from the coronavirus until a vaccine helps to create global herd immunity, the avoidance of an unforeseen outcome will, for many, be deemed too costly in comparison to the policies enacted. Research has been conducted on this point. For example, in the United States, elected officials are rewarded with votes and public approval for enacting reactive legislation in the form of economic relief for those suffering from a natural disaster. This is the case where it is shown the cost of reactive policies, such as financial relief, are five to six times more expensive than proactive policies to prevent the worst impacts of the disaster [14]. The point is incentives often create political demand for policies that are responsive to quantifiable harms. This leads to a reactive policy posture, particularly to large-scale problems that aggregate over time. So, what can be done? How can humans do a better job of proactively preparing for coastal hazards?

#### **4. Planning for Hazards along Coastlines: Confronting the Human Dimensions**

The fact that climate change is increasing the hazards of living along most coastlines is not in dispute. What is in dispute is what to do about it. For many coastal areas that are highly developed and low-lying, which incidentally include many of the great port cities around the world, adaptation must include proactive planning. For many reasons, including those outlined earlier in this article, proactive planning will be influenced by human perceptions, expectations, and the desire to externalize a risk that is not already internalized into coastal living. Meaningful proactive coastal climate change policy must reckon with existing policy structures and political systems that have existed under the belief that coastal areas are relatively safe and desirable places to live. The fact that the full costs of continued climate change will not be borne for decades to come undermines the ability of proactive policies to gain public attention and support. Even so, a few points can be made to aid in migrating coastal adaptation policies from entirely reactive to a more proactive form.

Elliot and Clement [15] have done foundational work in the United States on the relationship between coastal natural disasters and their impact on local development. For a variety of reasons, summarized by McGuire [16], current US policies incentivize coastal development in such a way that the disaster (a coastal hurricane for example) spurs a higher rate of development in the risky coastal area immediately after disaster, primarily due to a mix of national policies that unleash economic aid and other incentives. These policies stem from a larger contextualization of land as relatively unchanging. This contextualization presumes humans bring change to land, not nature. Policy is developed from this underlying presumption. For example, when a natural hazard, like a hurricane in the US, causes coastal storm damage, response planning in the aftermath invokes the belief that the storm event was an aberration, an abnormal and unusual occurrence. As such, planning goes into recreating what existed before the storm, which is supported by unified local public demand to rebuild and remain. Additionally, at least in the United States, the very process of redevelopment also spurs new development. Investments are made and remade in coastal areas experiencing incremental and aggregate risk increases due to climate change.

The presumption of land as a passive resource leads to reactive policy formulations. However, land is not really passive; it is in constant change [3] (pp. 3–19). Generally, that rate of change is historically slow from a human planning perspective, but climate change is increasing the rate of change, and this is particularly true of low-lying coastal areas, which have always been dynamic. In essence, coastal areas need to be seen as active hazard areas from a planning and policy perspective in order to incorporate the emerging and aggregating risks associated with climate change, and new policies need to be developed from this active hazard perspective.

There has been work undertaken to help define and understand what an active hazard framework for proactive coastal adaptation might look like [17]. Constructively, these policies need to incorporate the emerging risks of climate change towards coastal habitability as an overarching starting point from which all existing coastal land use and development policies can be evaluated. A large part of this process will be public education because public buy-in will be necessary to achieve the political will for proactive policy development. In the United States, for example, key national policies that continue to support a “coastal regions as passive resource” orientation have recently been under reexamination. One reason for this is the increasing expense of policies like national disaster relief and nationally subsidized flood insurance; as storms become more frequent and intense, the public costs of rebuilding in these areas become a political liability. In addition to increased public costs in support of coastal habitation, there is also an expanding public awareness and acceptance of climate change [18]. While awareness alone cannot solve the aggregating nature of climate change, episodic events help to create a “crisis moment” within the larger public awareness that can be utilized to garner public support for more proactive policy measures, even at the expense of reworking and dismantling existing policy structures.

## 5. Conclusions

The human dimensions of coastal adaptation strategies to climate change are fundamental and important considerations when contemplating existing and new policy directions. While the science behind climate change causes and impacts is clear, the expectation of a directed and proactive policy response by humans is less so. There are many reasons for this reality, some of which have been summarized in this communication. Fundamentally, like the current global coronavirus epidemic, climate change presents a challenge to long-held human beliefs and expectations about how we can, and should, live our lives. Asking for changes to pre-existing behavior is particularly hard when those changes provide immediate costs in the eyes of the regulated without offering clearly identifiable benefits that meet or exceed those costs. This will always be an issue with climate change policy in general because the effects and impacts of climate change—like a viral epidemic—are dispersed and aggregate over time. We seek to limit actions today to prevent the cumulative impact of a potential tomorrow: a difficult environment in which to create new policies.

This summary of policy aspects of the human dimensions of coastal adaptation strategies is presented to provide context for the research presented in this Special Issue. It does not cover all areas of the research being undertaken to better understand the human dynamics of coastal adaptation in an era of climate change, but it should help the reader place the body of research into a larger perspective. It is through the process of detailed investigation, and the ability to scale those investigative insights up to larger public policy considerations, that we can begin to see how to best equip ourselves to deal with managing our coastlines in a time of change.

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