RONALD COASE INSTITUTE
WORKING PAPER SERIES

Institutions and Adaptation to Climate Change in Developing Countries: A Literature Review

Annalise Helm and Dominic Parker

Working Paper Number 10
September 2024

Institutions and Adaptation to Climate Change in Developing Countries: A Literature Review

Annalise Helm and Dominic Parker
University of Wisconsin-Madison

September 2024

Abstract

Large numbers of people are affected by climate change and climate-related weather events such as droughts, wildfires, and floods. How do they adapt? And when are these adjustments hampered or aided by laws, norms, and policies? We review the literature, primarily in economics, to summarize what is known about adaptation decisions and their constraints. We find it focuses on four modes of adaptation: migration to lower risk areas, changes in land and resource use to reduce vulnerability, investments in resilient infrastructure, and more reliance on trade. Studies to date highlight how policies in developed countries have distorted incentives for people to efficiently adapt and therefore raised the costs of climate change. There is a relative dearth of analysis in developing countries, however. This is an important knowledge gap because climate change poses a larger threat to human livelihoods in low-income nations. More research is needed to understand the role of institutions in blocking efficient adaptation so that these obstacles can be overcome.

Introduction

How do institutions – the laws, customs, and norms that govern societies - encourage or hinder human adaptation to climate change? This question is important because climate changes are already provoking adaptation, and some actions are being channeled or blocked by institutions in ways that may be costly or inefficient. Identifying specific institutional barriers is critical for overcoming obstacles to cost-effective adaptation.

Our survey of the literature reveals helpful but limited study of the link between institutions and adaptation, especially in developing country settings. To be sure, we do know how national and local policies can motivate or discourage specific adaptive behaviors. For example, a city could raise property taxes on housing in flood prone areas. Or it could subsidize

development in those same areas. These policies have obvious and important effects on incentives to build, migrate, and invest in infrastructure.

But the role of institutions is much more ubiquitous, fundamental, and indirect as shown in Figure 1. Institutions affect wealth and the certainty and structure of market incentives (Ménard and Shirley 2005), and these factors affect adaptation capacity and incentives (Anderson et al. 2019). Property rights, rule of law, and the competitiveness of markets influence access to credit and basic services (education, transportation, sanitation) which enhance resilience to climate change. Institutions also affect the nature and presence of insurance markets, and the mobility of labor and capital, which in turn affect adaptive capacity and vulnerability to climate change.

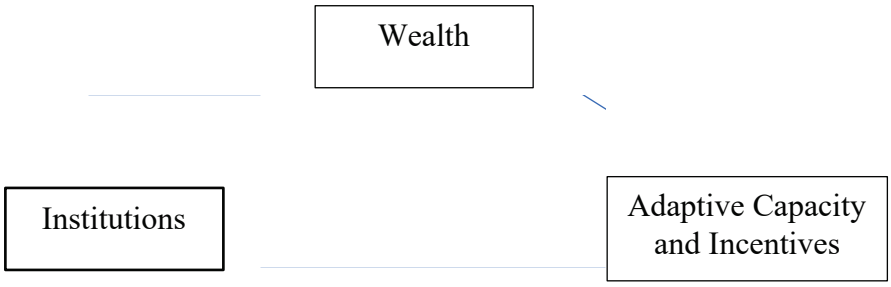

Figure 1: Direct and Indirect Effects of Institutions

Defining Adaptation

As the world reacts to climate change there are two primary paths of action: mitigation and adaptation. Mitigation refers to efforts and policies that reduce the amount of greenhouse gases released or that sequester carbon in an attempt to mitigate the pace of climate change and the severity of weather events. Adaptation refers to policies and actions that lessen costs to humanity of the effects of a changing climate, such as rising sea level, more frequent and intense

storms, drought, and other stressors. Effective adaptation can be local whereas mitigation requires coordination at a much larger, potentially global, scale.

Adaptation is related to resilience in that both can involve changes to the physical and social environment to reduce vulnerabilities to changing climate. An important distinction, however, is that adaptation is an adjustment to the circumstances of climate change, whereas the Intergovernmental Panel on Climate Change (IPCC) defines resilience as "the ability of a system to anticipate, absorb, accommodate, or recover from a hazardous event" (Field et al. 2012, Fankhauser 2017). Adaptation refers specifically to climate change induced adjustments, whereas resilience can encompass actions that improve an actor's ability to withstand many different kinds of hazards.

Both adaptation and resilience are discussed in the literature as functions of a community's or individual's financial, informational, and technological resources, as well as access to basic services and social capital (Florez Bossio, et al. 2019). An actor's ability to choose efficient adaptations is also determined by their access to markets, private property rights, and the availability of reliable information (Mendelsohn 2012). Having options to efficiently adapt reduces vulnerability to climate change.

Adaptation Actions

The economics literature on private adaptation actions has focused on four main pathways for responding to climate vulnerabilities. These are migration (Boustan et al. 2012, Fankhauser 2017), changes in land and resource use (Auffhammer and Carleton 2018), increased trade (Libecap 2007), and investing in resilient infrastructure (Millner and Dietz 2015). These channels for action apply to citizens in both developing and developed nations. Though there are

other channels for adaptation, for example through adjustments to credit and labor markets, the majority of research to date focuses on the four channels described here.

Human migration refers to moving from high-risk areas to lower risk areas (e.g. from a floodplain to higher elevations). Migration is generally voluntarily undertaken by people responding to risk signals, but risk signals may be clouded, providing opportunities for policies designed to motivate individuals to move to lower risk areas. Below we will highlight literature studying this pathway of adaptation and some of the institutional and policy barriers.

Investing in resilient infrastructure is a critical tool for adapting to climate change as well and includes actions such as floodproofing residential homes or building sea walls in preparation for sea level rise. These actions can allow individuals and communities to stay put, rather than migrate, in the face of an anticipated changes. Infrastructure investments in new roads, transportation networks, and sanitation systems may also provide an alternative to migration. These investments can improve resilience to specific climate shocks, but presumably could also increase resilience to other types of hazards.

Individuals can also adapt by changing land and resource use. Examples include switching to more heat-resistant crops or changing irrigation practices to conserve water. Policies and institutions can suppress or encourage land use adaptation, for example by subsidizing water use or certain crop production. Below we discuss specific adaptive behaviors highlighted in studies of agriculture that demonstrate both the efficacy of this action pathway and the potential institutional barriers to it.

Trade can also be a useful adaptation tool, as it allows people to more readily obtain or substitute for goods that may have become more costly to produce with the pressures of changing temperatures and precipitation. Recent literature shows that international trade allows

countries to adapt when their national level of production is impacted by climate change. Domestic trading also enables more efficient allocation of resources that may become more scarce or more abundant with climate change in both developed and developing countries. For example, climate change may cause drought patterns to change in some regions and flood patterns to change in others. This raises the value of win-win water trading, which is prevented by institutions in many jurisdictions across the world (Leonard et al. 2021).

Understanding differences in incentives and constraints faced by actors considering any of the four adaptation channels is essential to understanding the differences in adaptation between developed and developing nations. Research highlights how developing countries are not only the most vulnerable, but also have the least adaptive capacity (Edmonds, et al., 2022). The fields of institutional and organizational economics are particularly well suited for quantifying this adaptation gap and identifying the underlying sources of it.

Adaptation, Wealth, and Institutions

Institutions are the law, rules, and formal and norms that govern social behavior and affect collective action. Collective action is essential for mitigation, but it can also be important for adaptation. This is because governments can aggregate and respond to public demand for a service (in this case adaptive action) (Mendelsohn, 2012). Institutions also affect adaptation by supporting (or hindering) markets that create clear price signals. Accurate price signals are critical for motivating people to change behavior in response to climate change (Kahn, 2021). In short, institutions have the potential to be a powerful vehicle for change and progress, but only if institutions are not hindered by bureaucratic inertia and political barriers such as interest group opposition to trade that could otherwise facilitate adaptation.

As illustrated in Figure 1, the primary indirect channel through which institutions can enable adaptation is by fostering wealth generation. Empirical research assessing income, climate, and adaptation across 40 countries finds that mortality effects of extreme hot and cold temperatures are mitigated by higher incomes because it facilitates local adaptation to climate (Carleton et al. 2022). This complements related research, which has found that higher levels of wealth in cities and nations correlates with greater resilience in the face of climate shocks (Kahn 2005, Gandhi et al. 2022, Dell et al. 2012), less vulnerability to climate change and fewer mortalities (Saeed et al. 2023), and overall higher adaptive capacity (Anguelovski 2014).

The findings imply that communities in developed, higher income countries will have shorter recovery periods after a weather shock like a drought or flash flood, i.e. higher resilience. Higher income communities also have rich capital resources that enable more spending on adaptation, such as by investing in infrastructure. By contrast, communities in developing nations are not only more vulnerable to climate change, they are also more likely to suffer negative impacts to growth and economic life from climate shocks. Low-income individuals and countries are constrained to less expensive forms of adaptation, which may not be the most efficient course of action. This is in part because many in developing countries lack access to a capital market that would enable them to borrow to make investments in adaptation (Mendelsohn 2012).

This strong connection between adaptation and wealth has caused some researchers to argue that economic development is the best form of adaptation (Schelling 1992, 1997). By this thinking, many of the factors that determine the efficiency of an adaptation outcome are the same as those that contribute to economic growth such as good governance institutions (Bowen et al. 2012). The argument to focus on development first and foremost is further supported by research

that shows that the adaptation gap between developed and developing nations has been largely linked to literacy, income, income distribution, institutional quality, health spending, and access to finance (Fankhauser & McDermott 2014, Kahn 2005, McDermott et al. 2014, Noy 2009, Burton 2009, Fankhauser 2017). This leads to the conclusion that the same institutional barriers that obstruct economic growth will also be barriers to adaptation (Mendelsohn 2012).

Though wealth enables adaptation, the broader literature describes drawbacks to relying only on it as a remedy to climate risk. Growth is a slow process whereas climatic shocks can be sudden. This implies that institutions preventing certain types of adaptation may inhibit growth from occurring. For example, citizens in developing countries may migrate when their homelands lack institutions favoring adaptation in place. This outflow of human capital could prevent growth from occurring even if broader institutional improvements that promote growth are slowly taking hold. In more extreme cases, institutional barriers to adaptation could result in distortive actions that reduce wealth, such as fighting civil wars over resources made scarce by a combination of climate shocks and constraints on adaptation.

Institutions and Adaptation

Many barriers to adaptation are inherently connected to institutions, particularly in developing nations. Filho et al (2018) study adaptation efforts in six African cities. They find that common barriers to adaptation are limited financial resources, human capital skills, and access to information. Kuruppu and Willie (2015) in their study of adaptation in Small Island Developing States highlight the cost of poor cooperation due to weak linkages between national adaptation efforts and local government and poor coordination and communication between tiers of government. Castells-Quintana et al. (2018) argue that key barriers to adaptation can be

addressed by improving access to formal financial services (credit, insurance, cash transfer and social safety nets), providing information, and defining property rights.

Market Supporting Institutions

Most of the literature suggests that adaptation is more feasible and less costly when institutions support competitive markets. According to Besley and Ghatak (2006), market supporting public goods are "state interventions that make it feasible for the poor to participate in markets and hence benefit from gains from trade." They explain that the major roles of the state are to define and enforce property rights and to enforce and uphold a stable, predictable, and unbiased rule of law. Other public goods such as transportation networks and public information can improve opportunities for market participation and adaptation.

Several studies identify the barriers to adaptation as a lack of access to transportation, land, financial, and insurance markets, especially in developing counties (Haque, forthcoming, Mendelsohn 2012, Sanga 2021). For example, Sanga (2021) used simulation games to determine decision dynamics related to agricultural adaptation. They find that a key barrier is rules that limit access to full and secure land ownership for some farmers. They suggest improving access to land ownership and user rights for women, because women were shown to prefer a more diversified crop pattern that may be more resilient to climate shocks.

Other studies argue that supporting strong markets means eliminating laws that distort competition. Several studies have found that economic losses from climate shocks are higher when market competition is impeded (Kochar and Song 2024, Haque forthcoming). For example, Kochar and Song (2024) examine the impact of legally restricting agricultural sellers to a limited number of physical markets and government licensed intermediaries in India and show that such restrictions on spontaneous market competition reduce opportunities to sell in new

markets when crop yields are impacted by climate change. These market restrictions and frictions make it difficult to adapt efficiently. The authors find an increase in one standard deviation in their competition index can help farmers mitigate the negative effect of extreme heat on crop yield by 13.2 percent, meaning that fewer restrictions on markets helps farmers to adjust to a changing climate.

Migration

People have historically adapted to climate risks through migration. For example, research by Boustan et al (2012) investigating migration of young men to and from natural disaster struck areas finds that many left tornado struck areas in the U.S. during the first half of the 20th century. Conversely, the authors find that many traveled to areas that had been at high risk of flooding. One explanation they propose is that significant flood protection investment by the Army Corps of Engineers reduced flood risk and attracted new people to these areas. This example demonstrates both the migration response to a risk signal, and a way in which policy can promote adaptation to risk. However, institutions may mask the market signal to migrate away from a high cost (high climate vulnerability) area. For example, studies within the U.S. have shown that when the government chooses to rebuild, construct levees, or provide subsidies through cheaper insurance, people are more likely to stay in the high-risk flood-zone (Glaeser and Gyourko 2005, Ouazad and Kahn 2023, Ouazad and Kahn 2023).

Similar subsidies have encouraged people to live in high fire-risk zones. Baylis and Boomhower (2019) use data on firefighting expenditures in the western U.S. to estimate a geographically differentiated cost for protecting a home. They find that homes in fire risk areas often have a fire protection cost that exceeds 20 percent of the home's value, effectively subsidizing those living in a risky area though federal and state spending on firefighting and

prevention. Again, the option to adapt through migration is discouraged because the true cost of staying in a high-risk area is obscured.

In some cases, policies can even encourage migration to areas of higher climate risk. Glaeser and Kahn (2010) and Kahn (2011) describe how government zoning barriers to new housing in low carbon U.S. cities pushes people to migrate to higher carbon cities with more affordable housing. This provides a perverse signal to city administrators that citizens prefer high carbon living. Policy makers are not usually rewarded for carefully considering how laws might change incentives to migrate, while households are left with incomplete information about the costs and risks of their chosen locations.

Infrastructure Investment

Many studies conclude that investing in infrastructure is a central strategy for climate adaptation because it can improve resilience to climate shocks and facilitate adaptation to new climate conditions without having to migrate. Some common examples of adaptive infrastructure are raising the height of buildings and bridges to withstand flooding, building a seawall to account for rising sea level, and improving drainage systems to prepare for more frequent and intense flooding and storms. However, as institutions can mask or boost the signal to migrate, they can also mask or boost the signal to upgrade or invest in adaptive infrastructure. Institutions that distort labor and capital markets make it difficult and more costly to invest in infrastructure (Brooks and Liscow 2023) and decrease construction productivity (Goolsbee and Syverson 2023). For example, lengthy and expensive permitting and approval processes can slow down infrastructure projects, driving up their cost and delaying improvements in resiliency. Recent research finds that providing a discount on insurance, when certain self-protecting infrastructure investments are made, can encourage private investment in adaptive infrastructure. Boomhower

et al. (2023) find that such discounts increase self-protecting behavior, reduce losses from wildfires, and promote adaptation in high fire risk areas in the U.S.

Millner and Dietz (2015) compare investments in productive capital, such as in transportation infrastructure, which reduces vulnerability by increasing economic growth, and in adaptive capital, such as in water storage capacity, which helps to climate-proof a society. Their aim is to identify which type of investment results in the highest welfare benefit given an expected increase in average global temperature. First, they develop a theoretical model of the relationship between productive and adaptive capital, and then they calibrate this model to sub-Saharan Africa using numerical parameters derived by other researchers. This yields calibrated scenarios suggesting that investment in a mixture of both types of capital is optimal, but that investing in adaptive capital more aggressively than productive capital would produce the highest welfare benefits. The authors explain that this is because the returns to adaptive capital are greater than those to productive capital when the adaptive capital stock is low (due to assumptions of diminishing returns), and because the benefits of adaptive capital are assumed to not depreciate over time. Under these assumptions, anticipatory investment in adaptive capital produces a higher benefit than delayed investment as temperatures continue to rise and negative impacts continue to increase.

Land and Resource Use Changes

Researchers have documented ways in which agriculture in developing countries can adapt by changing crop mix and crop type to be more resilient to extreme heat and drought (Auffhammer and Carleton 2018, Taraz 2018, Boucher et al. 2021). For example, Auffhammer and Carleton (2018) find that maintaining a more diverse crop mix in India reduces revenue

losses after drought, and Boucher et al. (2021) document the benefits of employing genetically drought tolerant seeds in Africa.

Insurance markets are critical for mitigating risk brought on by climate change and for rewarding investment in new adaptive technologies. In the agricultural context, crop insurance mitigates farming risks related to unpredictable weather and a changing climate. But what conditions must exist to encourage insurance markets? The institutional context is key here. In order for insurance markets to function properly there must be enforceable contracts, verifiable property rights, sufficient information to assess risk, and limited moral hazard or adverse selection.

In the developed world these conditions are for the most part easily met, and insurance markets are able to mitigate risk of crop loss and reward farmers with lower premiums if they plant more resilient crops. Some insurance rules, however, have been shown to discourage this adaptive behavior, for example, subsidies for crop insurance in the U.S. slow responses to changing climate according to research by Annan and Shlenker (2015). This is because farmer risk is mitigated to the point where they no longer have incentives to experiment with new methods.

Other types of insurance are more successful in the developing world where countries often lack the strong institutional framework necessary for more standard insurance products. One promising approach is weather indexed insurance for agriculture, which can improve resilience in developing countries (Barnett and Mahul 2007, Clarke and Grenham 2013). Weather indexed insurance is insurance for farmers that pays out only if certain predetermined measures in a weather index are met. For example, if daily average heat reaches a threshold or inches of rainfall is lower than an established floor, farmers receive compensation for the crop

yield they may have lost due to these weather shocks. Barnett and Mahul (2007) argue that the advantages of weather indexed insurance include simplified insurance contracts, less potential for adverse selection or moral hazard because the weather index is common information and policyholders cannot affect it, and no farm-level risk assessment which means insurance companies do not need agricultural expertise to sell this product. This research shows that the type of insurance is critical in the developing country context where insurance is often difficult to administer, and agriculture is especially vulnerable to weather shocks.

The uncertainty around climate risk makes decisions to adapt stochastic and uncertain, but Hill and Viceisza (2012) suggest that when climate shocks are low frequency but high impact, access to credit and insurance in developing countries can improve a household's adaptive capacity and willingness to take on risky adaptation investments. As a large literature has shown, strong property rights are critical for motivating investment in land and agricultural productivity and to incentivize land use changes when relative prices of crops or input prices change. Mendelsohn (2012) applies these ideas in his study of adaptation to climate change. He argues that strong property rights enable adaptative investments and changes in land use. Conversely, when property rights are insecure, firms and households will underinvest in adaptation due to the uncertainty of accruing the long-run payoff.

Changes in agricultural land use are closely tied to changes in the agricultural labor sector. In the same way that farmers may choose to adapt to rising heat through diversifying or changing crop planting choices, laborers may choose to move out of the agricultural sector. Research has found that drought reduces agricultural employment (Albert et al. 2021), suggesting a move to sectors with less climate risk such as manufacturing. Colmer (2021) highlights this reallocation of labor in India and characterizes it as an adaptive behavior that

could reduce local economic losses from heat by up to 69 percent. This is because the productivity lost in agriculture can be partially replaced by expanded productivity in manufacturing. However, Colmer finds that efficient manufacturing expansions are constrained in localities with rigid labor market regulations. This means that laws and institutions governing labor are preventing climate adaptations that would otherwise attenuate major economic losses.

Trade

Related literature focuses on adaptation through trade which permits countries, communities, and individuals to compensate for the productivity losses (or gains) created by climate change. Examples include an actor trading with another for a crop that is negatively affected by a climate shock in one location but unaffected in another region, or trading in a water market to move water from a flooded area to one in a drought. Trade was utilized historically in Europe during the Little Ice Age, where an increase in international trade compensated for reductions in agricultural output caused by climate change (Waldinger 2022). Jurisdictions and nations can enable such adaptation by removing barriers to free trade. For example, Kochar and Song (2024) shows that restrictive trade laws have contributed to slow and limited adaptation in India and that eliminating laws that restrict farmers to selling produce only within their own state encourages more adaptive behavior. Similarly, research shows that regulatory barriers that impede trading in scarce resources like water in the American west can exacerbate the negative effects of climate change (Libecap 2007, Anderson et al. 2019,). In the case of water especially, property rights and pricing play an essential role in facilitating efficient adaptive trade (OECD 2008).

Conclusion

Institutions play an essential role in motivating or discouraging adaptation to climate change. They can indirectly encourage adaptation by generating economic growth, improving information about climate risk by strengthening market pricing signals, and constraining or allowing trade. Directly, institutions that regulate land use and labor markets, tax or subsidize certain markets, and removing barriers to trade in climate sensitive goods like water and crops. Interventions could range from minimal (e.g., removing barriers to adaptation and providing information about risk) to more extreme (e.g., subsidizing mobility and new infrastructure).

The literature linking climate adaptation to institutions is nascent and far from complete. Missing are systematic assessments of the extent of adaptation across the developed and developing world. Without such inventories, it is difficult to study how institutions inhibit or facilitate adaptation. Hence, fundamental contributions to the literature would include descriptive analyses of where, when, and how adaptation is taking place in vulnerable poor countries. Also missing are systematic assessments of the informal institutional arrangements that are being utilized to facilitate adaptation in the absence of insurance markets, credit markets, formal protections of property rights, and governance arrangements that competently provide public infrastructure. Research that uncovers how informal institutional arrangements promote adaptation pathways – such as migration, trading, labor reallocation, changing land use, and investments in resilient infrastructure - could help highlight where and when formal barriers and constraints are most consequential.

Works Cited

Albert, Christoph, Paula Bustos, and Jacopo Ponticelli. "The Effects of Climate Change on Labor and Capital Reallocation." Cambridge, MA: National Bureau of Economic Research, July 2021. https://doi.org/10.3386/w28995.

Anderson, Sarah E., Terry L. Anderson, Alice C. Hill, Matthew E. Kahn, Howard Kunreuther, Gary D. Libecap, Hari Mantripragada, Pierre Mérel, Andrew J. Plantinga, and V. Kerry Smith. "The Critical Role of Markets in Climate Change Adaptation." *Climate Change Economics* 10, no. 01 (February 2019): 1950003. https://doi.org/10.1142/S2010007819500039.

Anderson, Terry L. *Adapt and be Adept: Market Responses to Climate Change*. Hoover Institution Press, Stanford University, April 1, 2021.

Anguelovski, Isabelle, Eric Chu, and JoAnn Carmin. "Variations in Approaches to Urban Climate Adaptation: Experiences and Experimentation from the Global South." *Global Environmental Change* 27 (July 2014): 156–67. https://doi.org/10.1016/j.gloenvcha.2014.05.010.

Annan, Francis, and Wolfram Schlenker. "Federal Crop Insurance and the Disincentive to Adapt to Extreme Heat." *American Economic Review* 105, no. 5 (May 1, 2015): 262–66. https://doi.org/10.1257/aer.p20151031.

Auffhammer, Maximilian, and Tamma A. Carleton. "Regional Crop Diversity and Weather Shocks in India." *Asian Development Review* 35, no. 2 (August 2018): 113–30. https://doi.org/10.1162/adev_a_00116.

Barnett, Barry J., and Olivier Mahul. "Weather Index Insurance for Agriculture and Rural Areas in Lower-Income Countries." *American Journal of Agricultural Economics* 89, no. 5 (December 2007): 1241–47. https://doi.org/10.1111/j.1467-8276.2007.01091.x.

Baylis, Patrick, and Judson Boomhower. "Moral Hazard, Wildfires, and the Economic Incidence of Natural Disasters." Cambridge, MA: National Bureau of Economic Research, December 2019. https://doi.org/10.3386/w26550.

Besley, Timothy and Maitreesh Ghatak. 2006. Public Goods and Economic Development. In *Understanding Poverty*, eds. Banerjee, Behabou, and Mookherjee. Oxford, UK: Oxford University Press, pp. 285-302.

Boomhower, Judson, Meredith Fowlie, and Andrew J. Plantinga. "Wildfire Insurance, Information, and Self-Protection." *AEA Papers and Proceedings* 113 (May 1, 2023): 310–15. https://doi.org/10.1257/pandp.20231104.

Boucher, Stephen, Michael Carter, Jon Einar Flatnes, Travis Lybbert, Jonathan Malacarne, Paswel Marenya, and Laura Paul. "Bundling Genetic and Financial Technologies for More Resilient and Productive Small-Scale Agriculture." Cambridge, MA: National Bureau of Economic Research, September 2021. https://doi.org/10.3386/w29234.

Boustan, Leah Platt, Matthew E Kahn, and Paul W Rhode. "Moving to Higher Ground: Migration Response to Natural Disasters in the Early Twentieth Century." *American Economic Review* 102, no. 3 (May 1, 2012): 238–44. https://doi.org/10.1257/aer.102.3.238.

Bowen, Alex, Sarah Cochrane, and Samuel Fankhauser. "Climate Change, Adaptation and Economic Growth." *Climatic Change* 113, no. 2 (July 2012): 95–106. https://doi.org/10.1007/s10584-011-0346-8.

Brooks, Leah, and Zachary Liscow. "Infrastructure Costs." *American Economic Journal: Applied Economics* 15, no. 2 (April 1, 2023): 1–30. https://doi.org/10.1257/app.20200398.

Burton, I. Climate change and the adaptation deficit. *The Earthscan Reader on Adaptation to Climate Change* L Schipper, I Burton 89–98 (2009) London: Earthscan

Carleton, Tamma, Amir Jina, Michael Delgado, Michael Greenstone, Trevor Houser, Solomon Hsiang, Andrew Hultgren, et al. "Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits." *The Quarterly Journal of Economics* 137, no. 4 (September 20, 2022): 2037–2105. https://doi.org/10.1093/qje/qjac020.

Castells-Quintana, David, Maria Del Pilar Lopez-Uribe, and Thomas K.J. McDermott. "Adaptation to Climate Change: A Review through a Development Economics Lens." *World Development* 104 (April 2018): 183–96. https://doi.org/10.1016/j.worlddev.2017.11.016.

Clarke, Daniel J., and Dermot Grenham. "Microinsurance and Natural Disasters: Challenges and Options." *Environmental Science & Policy* 27 (March 2013): S89–98. https://doi.org/10.1016/j.envsci.2012.06.005.

Colmer, Jonathan. "Temperature, Labor Reallocation, and Industrial Production: Evidence from India." *American Economic Journal: Applied Economics* 13, no. 4 (October 1, 2021): 101–24. https://doi.org/10.1257/app.20190249.

Dell, Melissa, Benjamin F Jones, and Benjamin A Olken. "Temperature Shocks and Economic Growth: Evidence from the Last Half Century." *American Economic Journal: Macroeconomics* 4, no. 3 (July 1, 2012): 66–95. https://doi.org/10.1257/mac.4.3.66.

Edmonds, Heidi K., C. A. Knox Lovell, and Julie E. Lovell. "The Inequities of National Adaptation to Climate Change." *Resources* 12, no. 1 (December 28, 2022): 1. https://doi.org/10.3390/resources12010001.

Fankhauser, Sam. "Adaptation to Climate Change." *Annual Review of Resource Economics* 9, no. 1 (October 5, 2017): 209–30. https://doi.org/10.1146/annurev-resource-100516-033554.

Fankhauser, Samuel, and Thomas K.J. McDermott. "Understanding the Adaptation Deficit: Why Are Poor Countries More Vulnerable to Climate Events than Rich Countries?" *Global Environmental Change* 27 (July 2014): 9–18. https://doi.org/10.1016/j.gloenvcha.2014.04.014.

Field CB, Barros V, Stocker TF, Qin D, Dokken DJ, et al., eds. 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge Univ. Press

Filho, Walter Leal, Abdul-Lateef Balogun, Desalegn Yayeh Ayal, E. Matthew Bethurem, Miriam Murambadoro, Julia Mambo, Habitamu Taddese, et al. "Strengthening Climate Change Adaptation Capacity in Africa- Case Studies from Six Major African Cities and Policy Implications." *Environmental Science & Policy* 86 (August 2018): 29–37. https://doi.org/10.1016/j.envsci.2018.05.004.

Flórez Bossio, Camila, James Ford, and Danielle Labbé. "Adaptive Capacity in Urban Areas of Developing Countries." *Climatic Change* 157, no. 2 (November 2019): 279–97. https://doi.org/10.1007/s10584-019-02534-2.

Gandhi, Sahil, Matthew Kahn, Rajat Kochhar, Somik Lall, and Vaidehi Tandel. "Adapting to Flood Risk: Evidence from a Panel of Global Cities." Cambridge, MA: National Bureau of Economic Research, June 2022. https://doi.org/10.3386/w30137.

Glaeser, Edward L., and Matthew E. Kahn. "The Greenness of Cities: Carbon Dioxide Emissions and Urban Development." *Journal of Urban Economics* 67, no. 3 (May 2010): 404–18. https://doi.org/10.1016/j.jue.2009.11.006.

Glaeser, Edward L., and Joseph Gyourko. "Urban Decline and Durable Housing." *Journal of Political Economy* 113, no. 2 (April 2005): 345–75. https://doi.org/10.1086/427465.

Goolsbee, Austan, and Chad Syverson. “The Strange and Awful Path of Productivity in the U.S. Construction Sector.” Cambridge, MA: National Bureau of Economic Research, January 2023. https://doi.org/10.3386/w30845.

Haque, Islamul. “The Role of Land Market in Achieving the Scale for Adaptation to Climate Change: Evidence from Bangladesh,” n.d. https://www.islamulhaque.net/research.

———. “‘Underinvestment in a Profitable Adaptation Technology: The Role of Market Access,’” n.d. https://www.islamulhaque.net/research.

Hill, Ruth Vargas, and Angelino Viceisza. “A Field Experiment on the Impact of Weather Shocks and Insurance on Risky Investment.” *Experimental Economics* 15, no. 2 (June 2012): 341–71. https://doi.org/10.1007/s10683-011-9303-7.

Kahn, Matthew E. *Adapting to Climate Change*. Yale University Press., 2021.

———. “Do Liberal Cities Limit New Housing Development? Evidence from California.” *Journal of Urban Economics* 69, no. 2 (March 2011): 223–28. https://doi.org/10.1016/j.jue.2010.10.001.

———. “The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions.” *The Review of Economics and Statistics* 87, no. 2 (May 2005): 271–84.

Kochar, Rajat, and Ruozi Song. “Does Market Power in Agricultural Markets Hinder Farmer Climate Change Adaptation?” April 1, 2024. https://static1.squarespace.com/static/6334ef03eb02b95245b3c328/t/660b1cf33741e56d3a8c4679/1712004354607/Market+Power+and+Climate+Change+Adaptation.pdf.

Kuruppu, Natasha, and Reenate Willie. “Barriers to Reducing Climate Enhanced Disaster Risks in Least Developed Country-Small Islands through Anticipatory Adaptation.” *Weather and Climate Extremes* 7 (March 2015): 72–83. https://doi.org/10.1016/j.wace.2014.06.001.

Leonard, Bryan, Shawn Regan, Christopher Costello, Suzi Kerr, Dominic P. Parker, Andrew J. Plantinga, James Salzman, V. Kerry Smith, and Temple Stoellinger. “Allow ‘Nonuse Rights’ to Conserve Natural Resources.” *Science* 373, no. 6558 (August 27, 2021): 958–61. https://doi.org/10.1126/science.abi4573.

Libecap, Gary D. *Owens Valley Revisited: A Reassessment of the West’s First Great Water Transfer*. Stanford, Calif: Stanford Economics and Finance, 2007.

McDermott, Thomas K.J., Frank Barry, and Richard S.J. Tol. “Disasters and Development: Natural Disasters, Credit Constraints, and Economic Growth.” *Oxford Economic Papers* 66, no. 3 (July 2014): 750–73. https://doi.org/10.1093/oep/gpt034.

Ménard, Claude, and Mary M. Shirley. *Handbook of New Institutional Economics*. Dordrecht: Springer, 2005.

Mendelsohn, Robert. “The Economics of Adaptation to Climate Change in Developing Countries.” *Climate Change Economics* 3, no. 2 (2012): 1–21. https://www.jstor.org/stable/climchanecon.3.2.03.

Millner, Antony, and Simon Dietz. “Adaptation to Climate Change and Economic Growth in Developing Countries.” *Environment and Development Economics* 20, no. 3 (June 2015): 380–406. https://doi.org/10.1017/S1355770X14000692.

Noy, Ilan. “The Macroeconomic Consequences of Disasters.” *Journal of Development Economics* 88, no. 2 (March 2009): 221–31. https://doi.org/10.1016/j.jdeveco.2008.02.005.

OECD. *Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments*. Edited by Shardul Agrawala and Samuel Fankhauser. OECD, 2008. https://doi.org/10.1787/9789264046214-en.

Ouazad, Amine, and Matthew E. Kahn. “Mortgage Securitization Dynamics in the Aftermath of Natural Disasters: A Reply,” 2023. https://doi.org/10.48550/ARXIV.2305.07179.

Ouazad, Amine and Matthew Kahn. “Peltzman in Space”. 2023.
Saeed, Sahrish, Muhammad Sohail Amjad Makhdum, Sofia Anwar, and Muhammad Rizwan Yaseen. “Climate Change Vulnerability, Adaptation, and Feedback Hypothesis: A Comparison of Lower-Middle, Upper-Middle, and High-Income Countries.” *Sustainability* 15, no. 5 (February 24, 2023): 4145. https://doi.org/10.3390/su15054145.
Sanga, Udita, Amadou Sidibé, and Laura Schmitt Olabisi. “Dynamic Pathways of Barriers and Opportunities for Food Security and Climate Adaptation in Southern Mali.” *World Development* 148 (December 2021): 105663. https://doi.org/10.1016/j.worlddev.2021.105663.
Schelling, Thomas C. “Some Economics of Global Warming.” *The American Economic Review* 82, no. 1 (1992): 1–14. http://www.jstor.org/stable/2117599.
———. “The Cost of Combating Global Warming: Facing the Tradeoffs.” *Foreign Affairs* 76, no. 6 (1997): 8–14. https://doi.org/10.2307/20048272.
Taraz, Vis. “Can Farmers Adapt to Higher Temperatures? Evidence from India.” *World Development* 112 (December 2018): 205–19. https://doi.org/10.1016/j.worlddev.2018.08.006.
Waldinger, Maria. “The Economic Effects of Long-Term Climate Change: Evidence from the Little Ice Age.” *Journal of Political Economy* 130, no. 9 (September 1, 2022): 2275–2314. https://doi.org/10.1086/720393.