24 Climate Change Adaptation and Resilience

Sociotechnical and Knowledge Dimensions

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International efforts to reduce and sequester carbon dioxide and other greenhouse gases are not yet slowing the rate of anthropogenic climate change. The lack of progress has encouraged scientists and policymakers to consider ways of reducing impacts, especially in poorer countries with the least capacity to cope. Analysts now discuss the terms adaptation and resilience as ways to reduce the impacts of climate change alongside climate change mitigation, or the reduction of atmospheric greenhouse gas concentrations.

Adaptation describes actions that can make the physical effects of climate change less damaging. It is sometimes also referred to as adjustments in natural or human systems in response to the impacts of climate change. **Resilience** refers to the properties of people, places, or objects, such as infrastructure, to withstand climate risks. Resilience overlaps with adaptation because it includes the ability to undertake adaptation. But unlike adaptation, resilience is a characteristic rather than an action. Accordingly, policymakers now undertake activities to build adaptation and resilience within other social and political interventions, such as international development, capacity building, and planning, rather than through short-term activities to manage extreme weather alone.

Scholars in Science and Technology Studies (STS) seek to make adaptation and resilience more effective and socially inclusive by examining the tacit (or unacknowledged) frameworks guiding approaches to risk and societal response. By definition, adaptation and resilience imply responding to risks, which are often defined in terms of physical climatic events such as storms, floods, and droughts. However, the extent to which these events present risks often carry assumptions about how these events are hazardous. These assumptions might also include tacit beliefs about how different social actors might respond to these risks. For example, events such as Hurricane Katrina in the USA showed that not every social group experiences the risks linked to storms in the same way. Focusing on the physical impacts of the storm alone overlooks the deeper social structures that might make different people more or less vulnerable. Indeed, some scholars now worry that seeking to implement adaptation and resilience based on existing understandings of risk might result in maladaptation—or difficult situations when interventions to reduce risk make people more vulnerable or displace risks onto others. Accordingly, STS scholars ask how ideas of adaptation and resilience reflect visions of social order reproduced in the supposedly neutral language of risk management and adaptive capacity. STS research on adaptation and resilience seeks to make these terms more sensitive to these tacit framings, and to increase the social inclusivity of understandings of risk and social responses.

In this chapter, I discuss the development of ideas about adaptation and resilience within climate change policy. I demonstrate the value of STS scholarship in three key areas: the constitutional role of unexamined models of risk, the co-production of risk and social identities and agency, and tacit worldviews underlying approaches to resilience.

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The Constitutional Role of Risk

Risk can be interpreted in different ways. For many environmental scientists, risk is an indication of the statistical chance that events such as damaging storms or floods might occur. In this sense, "risk" is similar to "likelihood."

For many social and environmental analysts, risk also refers to the nature of hazards. Climate-related risks, for example, could include physical events arising from climate change such as floods, storms, and droughts. But this understanding of risk can also pose challenges. Events such as floods might not be equally hazardous to everyone. Moreover, the risk associated with floods might not arise from the physical event itself, but rather with the outcomes of these events such as displacement, loss of livelihoods, or death. Accordingly, there is a need to consider how far the terms used to indicate risk might actually represent where, how, and for whom risks are experienced.

STS scholars investigate these questions. For many STS scholars, "risk" refers to the frameworks that scientists or policymakers use to understand potential dangers. These frameworks of risk perform a constitutional role in defining how climate change might be hazardous and why people are at risk. The objective of STS research is to analyze how these frameworks might represent physical hazards or social responses in reduced ways, to ask what can be done to make each more diverse and inclusive.

Adaptation and resilience are examples of risk frameworks because they refer to responses to the risks posed by climate change. But discussions about climate risks, and hence adaptation and resilience, have undergone some important transitions over time. For some decades, research in anthropology and development economics discussed how vulnerable people might adapt to resource scarcity or other forms of hazards. These works tended to emphasize structural and political drivers of risk, such as long-term marginalization of people, and their ability to respond to risks through making institutions that regulated resource use (Watts, 2015). In the late 1980s, however, debates about adaptation focused increasingly on climate change and the influence of global systemic atmospheric change. The Intergovernmental Panel on Climate Change's (IPCC) first and second assessment reports in 1990 and 1996 initially defined climate risks in terms of additional units of atmospheric greenhouse gas concentrations because these can be linked to immediate impacts such as larger and more unpredictable storms, flooding, and drought. Accordingly, the IPCC Second Assessment Report defined adaptation and adaptability as:

> the degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate.
>
> (Watson, Zinyomera, and Moss, 1996, p. 5)

Some analysts have also argued that the IPCC represented risk in this way because it was consistent with its intention, especially during the 1990s, to represent scientific findings with one voice in a depoliticized manner. The IPCC makes it clear that its role is to summarize legitimate scientific research on climate change in ways that are policy-relevant, but never policy-prescriptive. This approach was justified to ensure that the knowledge generated by the IPCC can be trusted at a time when many climate change deniers claim that the science is politically motivated or reflects national interests. Referring to the atmospheric drivers of impacts therefore allowed the IPCC to represent risk in terms of global biophysical change, rather than in terms of social or economic structures (Beck and Forsyth, 2015).

This approach to risk, however, has limitations because it frames adaptation to climate change as a response to projected climate changes, rather than how these changes are experienced as

problematic by vulnerable people. According to this view, the risks posed by climate change arise from additional atmospheric greenhouse gas concentrations, rather than vulnerability to those concentrations. For example, adaptation to these definitions of risk focused on strengthening sea walls, roads, and bridges, or providing storm shelters. These actions can save lives and allow economies to function in the face of extreme weather. But they focus on the immediate physical impacts of climate change rather than removing social barriers that cause certain people to be more vulnerable than others (Nightingale et al., 2020).

Moreover, these early systemic definitions of adaptation tended to see adaptation as an objective only if mitigation policies fail. Indeed, some scholars have argued that the focus on global systemic change has led to an implicit bias against adaptation policies in the IPCC reports and, by extension, in policy discussions. In 1998, for example, one UNFCCC-related meeting in Tokyo witnessed the Chinese delegation accuse the USA of insufficiently helping poorer countries respond to climate change, such as through technological development. The representative of the USA replied by saying "let me remind delegates that we are discussing a climate change convention, not a convention about development, and so we should only refer to atmospheric greenhouse gas concentrations" (personal observation).

Indeed, later debates about funding for adaptation have led to lines being drawn between budgets allocated to "climate change policy" and "aid and development" to indicate the impact of atmospheric greenhouse gases rather than other driving forces of risk (Klein and Mohner, 2011).

Over time, however, approaches to climate risk, adaptation, and resilience have diversified. There is now a greater acknowledgment of socio-economic drivers of vulnerability and of the greater role of context in risk (Ayers, 2011). For example, the Working Group II of the IPCC Fifth Assessment Report (2014) noted:

> The rational-linear process that identifies potential risks then evaluates management responses … has been challenged on the grounds that it does not adequately address the diverse contexts within which climate decisions are being made, often neglects existing decision-making processes, and overlooks many cultural and behavioral aspects of decision-making.
>
> (Jones et al., 2014, p. 199)

In a document prepared for the Sixth Assessment Report, authors also acknowledged that risk should recognize the diversity of values and objectives associated with human and ecological systems. It emphasized that "the concept of risk should *not* be used to describe outcomes within physical systems only" (Reisinger et al., 2020, p. 6). Moreover, it stated that ideas of climate risk can refer to both impacts of, and responses to, climate change.

These changes in conceptualizations of risk allow a wider range of interpretations of adaptation and resilience. There is growing discussion of risk and loss in more flexible, personal, and emotional terms (Nightingale et al., 2021).

Co-producing Risk, Identity, and Agency

Research in STS also considers how frameworks of risk are co-produced with ideas of social identity and agency. For STS, **co-production** is a framework that acknowledges that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it (Jasanoff, 2004). Co-production is therefore a way to analyze how knowledge about adaptation and resilience can reflect tacit social structures, values, and

unseen codes of conduct. These factors can influence which knowledge is seen to be relevant, how it is collected, and how it is presented as authoritative. This information can relate to the representation of physical risks such as floods, or human responses to these risks.

Yet, in recent years, many environmental scientists and authors of IPCC reports have used the term co-production in different ways. These analysts have instead represented co-production as a cognitive process of co-owning research practice between scientists and relevant stakeholders through consulting with local people, or different users of research, while undertaking the research. Indeed, this kind of consultation has been called the gold standard of engaged science (Lemos et al., 2018).

Yet, the STS interpretation of co-production can illustrate ways in which formal approaches to adaptation and resilience can imply social responses to risk in ways that can be illusionary. One example is the distinction made under the IPCC's Fourth Assessment Report between "planned" and "autonomous adaptation" (IPCC, 2007). Planned adaptation referred to deliberate interventions to anticipate anthropogenic climate change. Autonomous (or spontaneous) adaptation included unconscious responses to climatic stimuli triggered by ecological changes in natural systems and/or market or welfare changes in human systems. Autonomous adaptation might include altering agricultural inputs, introducing water-managing technologies, altering cropping cycles, or diversifying economic activities.

This distinction between planned and autonomous adaptation, however, implies that people's changes in risk management only occur in response to climate change, rather than because of other numerous, long-term socio-economic transitions that might predate climate change. For example, much research on problems such as dryland degradation or soil erosion in developing countries has argued that adaptive responses at the local level are not simply driven by environmental changes *per se*, but in how environmental changes present hazards for vulnerable people's livelihoods and assets (Ribot, 2010). Adaptation, therefore, need not only include practices that lessen impacts of environmental change on currently productive resources, but also comprise forms of livelihood diversification that *de facto* make the impacts of these changes on existing resources less threatening. But also, some forms of so-called planned adaptation might impede pathways to this broader form of autonomous adaptation. For example, research in Thailand showed that the national government tried to encourage "adaptation" to climate risks by using tree plantations to stabilize slopes in agricultural zones to address risks such as landslides. But planting trees on agricultural land also reduced the possibility for farmers to continue or diversify agricultural livelihoods (Forsyth and Evans, 2013).

The point is that models of risk pre-shape expectations of how people might respond. But using fixed frameworks of risk can hide how people actually experience environmental changes as hazardous. They might also worsen those experiences of risk. This unfortunate outcome might also be a form of maladaptation.

As mentioned above, maladaptation occurs when attempts to build adaptation to climate risks end up increasing people's vulnerability or displacing risks onto other people (Schipper, 2020). Much early discussion of maladaptation highlighted technological interventions that were insufficient for addressing climate change: for example, coastal defenses that displaced wave action onto other locations, or high-energy air conditioners to counter heat waves. More recent research has defined maladaptation more in terms of interventions that fail to acknowledge deeper social and economic structures. For example, some adaptation interventions in Africa have assumed that stable labor markets are a pathway to resilience, but long-standing research in Africa has shown that flexible and dynamic markets offer a more diverse range of livelihoods for less advantaged workers. Adaptation defined in terms of stable labor markets can therefore exacerbate social inequality. A common problem here is how so-called "success" in adaptation

projects might be defined by dominant development agendas rather than from a participatory and inclusive form of knowledge co-production (Eriksen et al., 2021).

For many STS scholars, however, maladaptation also arises from the application of risk frameworks that simultaneously simplify experiences of climate change and people's responses to them. For STS scholars, these challenges cannot be addressed by short-term consultation with stakeholders. Rather, there is a need to consider deeper, and less cognitive forms of consultation and social justice. This interpretation of co-production does not focus only on how to allocate climate policies more successfully to specific groups, but also considers how underlying beliefs and worldviews simultaneously shape both "what" is being allocated and to "whom."

The example of community-based adaptation (CBA) to climate change shows the challenges of co-producing risk and social agency in this way. CBA has been discussed within climate change policy since the early 2000s to allow local and vulnerable people opportunities to shape adaptation interventions (Ayers et al., 2014). It reflects long-term thinking about the benefits of community-based natural resource management and participatory development. It aims to achieve outcomes that are better attuned to the social drivers of vulnerability to climate change, including the social, economic, and political contexts of poverty. This work aims to diversify the understanding of risks posed by climate change and provides a more socially sensitive form of risk assessment that relies on predictions of physical changes such as floods and droughts alone. For example, community-based forms of adaptation can highlight the challenges for different social groups within localities to access freshwater or ensure that adaptation interventions such as new wells and water tanks are accessible to everyone.

There are many good reasons for local people to shape adaptation interventions. But critics have also questioned many assumptions underlying CBA. STS scholars have asked how far ideas of "community" and "climate risk" might be co-produced in ways that simplify and reduce scrutiny of both terms. For example, various scholars in international development have argued that the term "community" is simplistic and potentially damaging because it implies that local people act as a homogeneous unit. Many villagers or local groupings of people contain internal divisions and cases of exploitation, or even oppression, which can be a significant cause of poverty and vulnerability. Customary practices within communities, for example, can replicate exclusionary practices, such as forbidding women to own land or prescribing social roles that can be considered disempowering. Moreover, communities rarely can challenge deeper political, social, and economic driving forces of poverty, such as the state's role in controlling investment and access to services or the reliance of poorer countries and regions on international trade flows. Indeed, some development analysts have expressed concern that community-based adaptation and resilience approaches can be captured by elite interests or only succeed under restricted circumstances (Forsyth, 2013).

There are also concerns that CBA might focus on earlier understandings of global climate risk rather than the local and contextual drivers of vulnerability to risk. For example, some discussions of CBA might consider the location of physical infrastructure for risk avoidance, such as storm shelters and freshwater tanks. Such infrastructure can be crucial in saving lives during storms or tidal surges in locations such as Bangladesh. But this kind of discussion does not consider longer-term transitions in livelihoods and political rights that might drive a more holistic ability to withstand environmental hazards.

CBA can also represent climate risks and local communities in reduced ways. One example is floating gardens in northern Bangladesh. In this location, development organizations have highlighted how women have developed ways to use floating water hyacinth plants (a common weed) to make platforms to hold soil and grow vegetables at times when other land is flooded. Development agencies have used this example of successful CBA. Yet, critics have also pointed

out that this colorful story also presents a supposed image of success that also presents women standing deep in floodwater in ways that bypass broader questions of gender inequality. Indeed, it is important to see how climate change policy approaches might become "adaptation regimes" based on how proposed solutions engage with various deep-set structural causes of vulnerability (Masud-All-Kamal and Nursey-Bray, 2022).

Some approaches to community-based adaptation therefore rely on representations of climate risk and community that can be reductionist and at times even romantic. Analysts therefore increasingly stress the importance of broader processes of social transformation, which are more powerful than narrow representations of community action alone.

Resilience and Normative Values

STS also considers worldviews and values in supposedly neutral science. This is now a theme for research on resilience to climate change. STS scholars therefore ask, how do tacit values shape what policymakers mean by resilience? What assumptions about risk and social agency do they carry? And is it possible to gain lessons for building resilience that are transferable between different contexts?

Conceptualizations of resilience have also changed over time. During the 1970s the term usually referred to physical properties of infrastructure or ecosystems, such as the ability of systems to withstand shocks (Holling, 1973). An increasing number of analysts, however, argue that resilience not only refers to physical properties of infrastructure or ecosystems, but also to socio-economic factors such as people's ability to access diverse livelihoods, or avoid long-term drivers of social vulnerability (Béné et al., 2014). For example, some development agencies have defined resilience in terms of the "3As" framework to combine anticipatory, absorptive, and adaptation capacities. These capacities focus on knowing in advance about risks, dealing with them when they occur, and then adopting long-term acts of adaptation that can reduce vulnerability.

But various analysts both inside and outside of STS have argued that these technical frameworks of climate resilience reproduce social and economic orders (Brown, 2016). In particular, some analysts have claimed that the term "resilience" has now become co-opted into neoliberal thinking that has dominated economic and development policies since the 1980s based on ideas of market dominance, a small business-friendly state, and opposition to trade unions (Chandler and Reid, 2016). For example, strategies such as livelihood diversification or more formal development policies such as Sustainable Livelihoods Approaches have been criticized for enabling a discourse that national governments no longer have to work to reduce poverty or provide safety nets. According to this neo-liberal perspective, "successful" resilience is when individuals are free to serve markets, and states do not need to intervene.

Moreover, in these circumstances, various definitions and pathways to resilience might exist at the same time or fail to address deeper drivers of vulnerability. For example, research in Myanmar showed that different development organizations claimed to achieve resilience by diverse activities with different levels of engagement with social and political structures. In one region, a non-governmental organization (NGO) claimed to build resilience to climate shocks by sending flood warnings to people's mobile telephones. This activity added to "anticipatory capacity" by informing people of a significant hazard. But it failed to acknowledge social inequalities in land ownership or labor markets. For example, in one region of Myanmar where the warning was applied, land ownership might be concentrated among some 20 percent of households while the remaining 80 percent would work in casual labor, often for the landowners. Advance warning of flooding might therefore allow landowners to protect their livelihoods by harvesting crops, but it will do little to protect the livelihoods of casual laborers who might find a shortage

of employment after the floods (Forsyth, 2018). Similar findings have been recorded in Bangladesh (Paprocki, 2018).

In this case, the definition of resilience reflected the underlying philosophy of development organizations. For example, some organizations focus on technological interventions such as providing wells or building sandbanks on riverbanks. Other organizations seek to build social rights and empowerment such as by choosing and hiring village champions (often women) who can then instigate local change. Each organization will define and measure resilience in different ways. However, all organizations also need to follow other constraints. For example, many development organizations work in authoritarian countries where governments suppress political rights and might expel organizations seen to be challenging their political order. Researchers and policymakers can adopt insights from STS by refusing to conflate short-term objectives of resilience (such as delivering text messages) with longer-term shifts in vulnerability. Moreover, definitions of resilience (similar to definitions of risk) should include social drivers of vulnerability, including political constraints on rights, but these are difficult to measure and monitor for methodological, institutional, and political reasons (Nightingale et al., 2018).

Conclusion

STS has contributed to the analysis of adaptation and resilience by highlighting the contingent and co-produced nature of risk, response, social values, and social identities. A core objective of this work has been to show that notions of risk are not fixed or separate from social context but reflect and can even shape inequality and values within society.

Yet, while this work has sought more flexibility and social inclusion in how we understand adaptation, many policy initiatives still seek to define adaptation in more universal and less contextual ways. The Global Stocktake, for example, is an assessment that considers how different countries have made progress in achieving long-term goals on mitigation and adaptation after the Paris Agreement. It is important not to dismiss progress on adaptation and resilience so far, as these can protect against climate change. But at the same time, it is crucial to consider how far these existing parameters of adaptation might still contain blind spots in how they define risk, why people are vulnerable, or how frameworks of risk and response might even reproduce existing social inequalities.

Moreover, much discussion within environmental policy acknowledges the need for greater social participation. These discussions include terms used in STS such as co-production, but the use of these terms in environmental science can be very different from the meanings adopted within STS. STS adds to these approaches by examining how assumed facts or scientific bases of policy (such as frameworks of climate risk, or the expected social responses of communities) are themselves held in place by larger social structures. Using STS allows a deeper level of democratization of adaptation and resilience by showing how these terms exist in association with different worldviews, values, or historic experiences. Listening to this research can allow researchers and policymakers to make approaches to adaptation and resilience more varied and socially inclusive, but also avoid potentially unhelpful outcomes.

Applying STS to adaptation and resilience, therefore, starts with asking how ideas of risk and social response are made together, and what social forces keep both stable and unquestioned. Diversifying ideas of risk and response can help make climate change science and policies more socially inclusive and effective for a wider set of challenges arising from climate change. It can also demonstrate and overcome the shortcomings of approaches to adaptation and resilience based on limited understandings of risk and social agency.

Further Reading

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