Environmental and Energy Study Institute

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Fact Sheet

Strengthening Financial Resilience to Climate Change: The Role of Insurance

August 2018

Every year, natural disasters inflict damages costing hundreds of billions of dollars globally – and the cost is rising. Climate change creates a more volatile weather system in which hurricanes, storm surge, wildfires, and other climate-related disasters are becoming more frequent and intense. The National Centers for Environmental Information, part of the National Oceanic and Atmospheric Administration (NOAA), records the number of natural disasters that cause at least a billion dollars in losses in the United States – 'billion-dollar' disasters. In 2017, there were 16 'billion-dollar' disasters with losses totaling more than $300 billion, a record high. These extraordinary losses, although unprecedented, were not entirely unexpected. The frequency of 'billion-dollar' disasters (adjusted for inflation) has been increasing since the 1980s. Between 1980 and 2012, there were on average 5.3 'billion-dollar' disasters per year in the United States. In the last five years, 2013-2017, the average was 11.6 such disasters per year.[1]

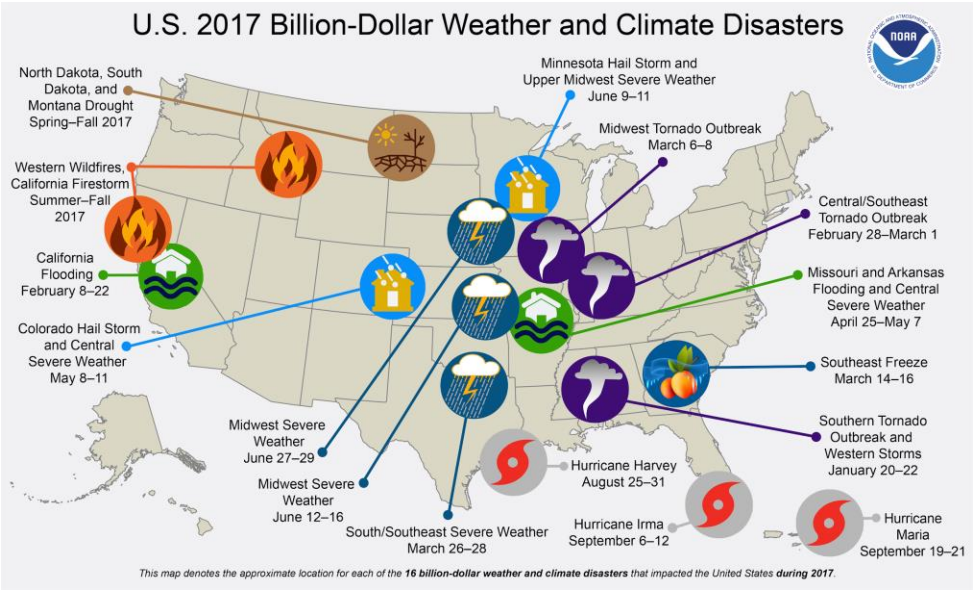


Figure 1. A visual representation of the 'billion-dollar' disasters that occurred in the United States during 2017. Source: NOAA[1]

Climate change is increasingly a fiscal matter, as natural disasters strain national budgets, displace millions of people globally, and impede economic growth. The initial cost of damages caused by a disaster are often multiplied over the recovery period, due to indirect losses such as business interruption and job losses.[2] The result is fiscal instability that burdens taxpayers and heightens the uncertainty experienced by disaster victims. Indeed, the increasing prevalence of natural disasters creates challenges for countries across the income spectrum, although the problem is often more severe for low- and middle-income countries that must take on considerable debt to recover from disasters.

Insurance is a financial mechanism for financing the costs of disaster in advance. It works by transferring risk from an individual policyholder to a risk-sharing pool, managed by the insurance provider. Insurance consumers make regular payments, known as premiums, which the insurance provider holds and invests, and then pays back to customers after a disaster. Reinsurance facilitates a higher level of risk-sharing by providing a risk-sharing pool for large businesses, governments, and other insurance companies. Insurance helps mitigate the financial shocks of disaster, promotes risk awareness, and, by putting a price tag on climate change risks, insurance incentivizes risk reduction.[3] Indeed, providing insurance requires detailed information about disaster exposure, information that is essential for disaster preparedness and risk reduction. When disaster strikes, insurance can mobilize economic resources efficiently through swift, reliable, and transparent payouts. These services can help stabilize the economy and provide a buffer against climate change for financial institutions, investors, and businesses.

Climate change poses serious risks to the insurance industry. The extreme weather patterns associated with a changing climate – sea level rise, frequent flooding, stronger hurricanes, larger wildfires, etc. – will affect the industry's financial viability. In the United States, according to Zillow Research, "almost 1.9 million homes – worth a combined $882 billion – are at risk of being underwater by 2100."[4] As climate change progresses, it will be increasingly expensive to insure individuals. Still, the insurance industry can reduce these costs by encouraging policy-holders to prepare for extreme weather events. For example, Chubb Ltd. (an insurance company) compensates policy-holders when they take preemptive measures to reduce the damages of extreme weather events, such as placing hurricane shutters on buildings or choosing to live in less flood-prone areas.[5] These types of policies benefit insurance companies (their costs are reduced when people are more prepared for disasters) and they improve the resiliency of communities.

The insurance industry has hundreds of years of experience managing climate-related risks, but climate change is altering the nature of these risks and testing the limits of conventional insurance models. Insurers fear that climate change threatens the essential "insurability" of disasters. The insurance industry's historical business model is designed for low frequency, high intensity events. Climate change could make disasters more frequent *and* more intense in many areas, thus undermining the economic viability of traditional insurance schemes. Global insurers have a financial stake in the future of climate change, and are highly motivated to respond proactively to the threat climate change poses. Through its ongoing work with governments, development organizations, scientists, and other stakeholders, the industry has developed alternative insurance schemes to manage and reduce the risks of climate change. This fact sheet will cover some of these emerging forms of climate insurance and the insurance industry's unique advocacy for action on climate change.

The Insurance Protection Gap

The "protection gap" refers to the difference between the economic losses inflicted by a disaster and the amount of those losses covered by insurance. Reinsurance giant Swiss Re's annual market report, *Sigma*, provides the most up-to-date analysis of the global protection gap. The *Sigma Report* for 2016 found that insurance losses that year amounted to less than one-third of the approximately $175 billion in total disaster-related losses, leaving a protection gap of $121 billion.[6] The global protection gap has widened significantly over the past 25 years. Average total losses are increasing faster than insured losses globally. The protection gap is not only a problem for low- and middle-income countries with historically low (or nonexistent) rates of insurance participation, but also for high-income countries with well-established insurance markets. For example, flood risks in the United States are significantly underinsured. The National Flood Insurance Program (NFIP) covered only 17 percent of the losses in Hurricanes Katrina and Sandy.[6] In developing countries, the insurance gap is often even worse. Hurricane-prone

Haiti, for instance, has a very low rate of insurance coverage: fewer than 3 percent of Haiti's 10.5 million residents own any kind of insurance.[7] While insurance itself will not prevent catastrophic losses, it serves as an important tool to help countries and households rebuild and recover after a natural disaster. Natural disasters that strike countries with extremely low insurance rates and low income levels (like Haiti) are incredibly costly and difficult to recover from.

Forces contributing to the growing protection gap include: urbanization, globalization, and climate change.[2] For the first time in history, the global urban population outnumbers rural populations. Urbanization has led to a concentration of people and assets in urban areas, which are often located on coasts or floodplains and highly exposed to natural disasters (more than one third of humans live within 60 miles of an oceanic coast[8]). This growing trend will increase the damages associated with extreme weather events. Take, for example, Miami – a city well-known for its vulnerability to rising seas and hurricanes. In Miami, the sea level is projected to rise six to ten inches above its 1992 levels by 2030. Yet, despite the encroaching sea and looming threat of storm surges, the city's population has increased at a rate of eight percent a year – *twice as high as the national average*.[9] This growth exposes more people and infrastructure to climate disasters, increases the total cost of climate-related damages, and enlarges the protection gap. Issues of cost and affordability and who pays are major questions to be resolved.

Globalization has a similar effect: by concentrating production, global supply chains are more vulnerable to disaster-related disruptions.[2] Global supply chains are more interconnected than ever before – if one part of the supply chain is affected by a climate related-event, then the rest of the supply chain is also affected. A case in point is the widespread economic disruption caused by severe flooding in Thailand in 2001.[10] As a key manufacturing hub for cars and electronics, its factory closures affected major companies like Apple, Canon, Honda, Nissan, Sony, Toshiba, and Toyota, which all experienced production slowdowns. Such slowdowns can be incredibly costly if they last long, which is not unusual. It takes time for manufacturing plants to return to normal operations, especially if they aren't insured.

Climate change increases the frequency and intensity of weather disasters, compounding the effects of urbanization and globalization and further contributing to losses. Climate change can cause 1-in-50 year storms to become 1-in-20 year storms, raise sea-levels that erode the traditionally "safe" boundaries of coastal cities, and result in more extreme weather that damages buildings and other major structures. Insurance experts have stated that climate change is turning what used to be rare events into common occurrences – or turning "risks" into "inevitabilities."[11] Companies risk losses if they insure homes located in areas that are virtually guaranteed to experience climate change-related damage, because the damage (and cost) will be greater.

Sophisticated Risk Modeling Accounts for Future Impacts of Climate Change

Insurance companies need to be acutely aware of risks to manage them effectively. The industry relies on sophisticated risk modeling systems called "cat models" (short for catastrophe models) to inform their underwriting process. The first advanced cat models were developed in the 1980s, but did not become widely used by insurers until the 1990s. Unprecedented insurance losses inflicted by Hurricane Andrew in 1992 made the industry realize that traditional actuarial science based on historical data was unable to properly calculate risk exposure for infrequent and extreme events.[12] Indeed, insurers have come to realize that the historical record is an increasingly flawed basis for predicting disasters. The cat models used today are more forward-looking and incorporate cutting-edge meteorological science.[13] These models are an integral part of the modern insurance business and, as a result, the insurance industry is aligned with climate science in a way few other industries are.

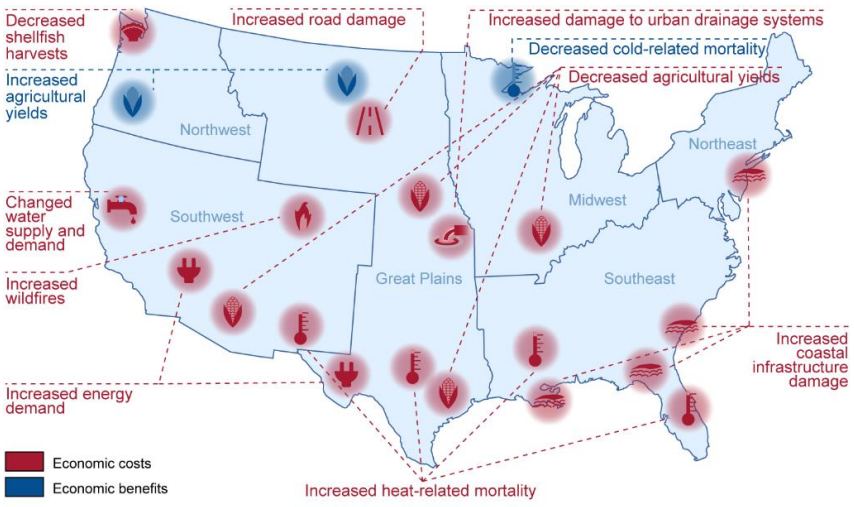
Geospatial models are another type of model used by insurance agencies. These models allow companies to analyze disaster risk at a micro-level, so that insurers can model and evaluate the risk of insuring a certain home or

neighborhood and accurately price insurance for that specific customer. This incentivizes customers to purchase homes or buildings that are low-risk (and thus will have a lower cost of insurance while mitigating climate change-related damages).[7, 13] Aviva Insurance, for example, employs "detailed topographical data to assess varying flood risks for coastal houses."[14] This small-scale assessment technique allows Aviva to determine which buildings are the most susceptible to natural disasters, and thus which buildings are the most expensive to insure. Aviva can fine-tune its insurance pricing to reflect the true cost of living in weather-risky/flood-prone areas.

Ceres, an advocate for sustainable businesses practices, defines an effective climate risk model as one that accounts for climate trends that deviate from historical trends, is "stress-tested" by adapting the model to a variety of potential climate scenarios, and projects one to five years into the future (because insurance policies are renewed annually, conventional models look ahead only one year at a time).[15] In 2014, Ceres surveyed insurance companies to assess how well they integrated climate change into their risk modeling processes.[15] Top-scoring insurance companies reported engaging with climate science by funding research, working with expert risk modeling firms, and making use of public data from the Intergovernmental Panel on Climate Change (IPCC), U.S. Global Change Research Program (USGCRP), and other public institutions.

Combining Insurance Risk Modeling with Climate Change Science

The Risky Business Initiative, started in 2013 by then-Mayor of New York Michael Bloomberg, produced a comprehensive, nationally-scaled study of the economic impacts of climate change in 2014. The risk modeling firm Risk Management Solutions (RMS), a private firm serving global insurance companies, contributed models to the research on coastal communities. As the report explains, "While not traditionally used in this way, [the insurance models] are incredibly powerful tools for understanding how climate change will likely shape both industry and coastal community risk exposure in the years ahead."[16] RMS created 20 versions of their storm surge model to reflect gradual sea-level rise and found that sea-level rise alone has the potential to double the economic losses of hurricanes by 2100.[16] RMS also generated hundreds of hurricane frequency models based on the "Representative Concentration Pathways" developed by the IPCC.[16]



Sources: GAO analysis of Environmental Protection Agency, *Climate Change Impacts in the United States: Benefits of Global Action* (Washington, D.C.: 2015), and Solomon Hsiang et al., "Estimating Economic Damage from Climate Change in the United States," *Science*, vol. 356 (2017); Map Resources (map). | GAO-17-720

Figure 2. Examples of Potential Economic Effects of Climate Change by 2100. Source: U.S. Government Accountability Office (GAO)

The *American Climate Prospectus* study (by the Rhodium Group) and the *Climate Change Impacts and Risks Analysis* (by the Environmental Protection Agency) provided the basis for a 2017 report by the Government Accountability Office (GAO) urging the federal government to plan for the economic risks associated with climate change.[17] This GAO report thoroughly examines the economic risks that climate change poses to the United States and recommends that the President incorporate this information into decision-making processes. Doing so can help the federal government better prepare for imminent climate change-related risks while providing the public with information about the government's climate preparedness. One of GAO's recommendations is to have the executive branch establish "a strategy to identify, prioritize, and guide federal investments to enhance resilience against future disasters."[18]

Innovative Insurance Products Address Climate Change

Catastrophe Bonds: Spreading Risk across Capital Markets

As climate change undermines the profitability of conventional insurance schemes, alternative methods of risk financing have emerged to protect against risks on the fringes of "insurability." Catastrophe bonds ('cat bonds') are an increasingly popular insurance alternative for financing "tail risks." A "tail risk" describes an extremely rare and destructive weather event. The name comes from the standard, bell-curve-shaped probability distribution, where rare events occur at the far ends – the "tails" – of the distribution. Climate change increases the frequency of these tail risks (so they become "fat tails"), and it increases the likelihood that normally separate "tail events" will occur simultaneously.[19] Tail risks are so destructive and costly that they can repel insurance companies from risk markets. Cat bonds were developed following Hurricane Andrew in 1992 to address this issue. Hurricane Andrew resulted in massive damages, causing eight insurance companies to declare insolvency and many others to abandon the flood insurance market in Florida. In fact, the Florida state legislature enacted legislation to prevent insurers from leaving the state, and to create a state lender of last resort. Without insurance companies, a natural disaster could completely destroy the livelihood of individuals and haunt communities and regions for years, even decades, after striking. Insurance is vital to the resiliency of communities.

A cat bond is an insurance-linked security, sold by an at-risk party (usually a government or municipality) to investors. If a disaster strikes, the cat bond funds recovery, just like an insurance payout, and investors lose some or all of their investment. The trigger for a cat bond is an extreme disaster with a low probability of occurring, such as a Category 5 hurricane. If no disaster strikes during the bond period, investors are paid back with a generous rate of return.[20] Investors essentially bet on the likelihood of a disaster occurring when they invest in cat bonds. Betting on hurricanes might seem like a gamble, but these investments can diversify investors' portfolios. Cat bonds are an excellent way to diversify because their performance does not generally correlate with the swings of the stock market.[21]

Cat bonds succeed where conventional insurance fails by spreading risks farther. Traditional insurance can only spread risks across the *insurance market* itself, which has significant capacity, but not enough to capture the full breadth of risks. When a massive disaster strikes, the insurance market may be too small to absorb the economic losses. Cat bonds, on the other hand, expand the market for risk: they allow private investors to take on economic risk. Private investors can buy cat bonds from insurance companies and, after a natural disaster hits, these investors are liable for part of the insurance costs (usually when the costs exceed a certain amount). Cat bonds therefore transfer risks to the broader *capital markets* – markets which allow for greater risks and absorb more losses. This increased market capacity allows the insurance industry to continue providing insurance to cities and communities, even as the losses associated with climate change continue to increase.

Case Study: Cat Bonds Protect New York City Metro from Storm Surge Threats

Hurricane Sandy caused storm surges that wreaked havoc on New York City's public transportation infrastructure in 2012. The storm caused an estimated $4-5 billion in damages to Metropolitan Transportation Authority (MTA) assets. At the time, MTA was only insured up to $1 billion. After the storm, MTA's insurance rates doubled, forcing the municipality to pursue a new risk management strategy. MTA issued a three-year, $200 million cat bond in 2013 to supplement its regular insurance coverage. MTA employed Risk Management Solutions (RMS) to construct a cat model for hurricanes and MTA infrastructure. The cat model generated a storm surge threshold to trigger the cat bond: 8.5 feet in some critical areas, such as the Battery, and 15.5 feet in other areas. Existing tidal gauges operated by the United States Geological Survey (USGS) and NOAA provided storm surge monitoring. If another Sandy-scale hurricane had struck New York before August 2016, investors would have lost their $200 million investment, a

significant risk, but the odds were in the favor of investors. NOAA's HURISK program, which predicts the return path of storms, estimated that a hurricane like Sandy would strike New York City only once every 175 years. The 20 investors in the MTA cat bonds received a 13.5 percent return on their investment in 2016, a profit of $27 million.[22]

Microinsurance: Mitigating Climate Change Risks in the Developing World

Insurance plays a distinct role in climate mitigation and adaptation in the developing world. Working with NGOs and national governments, the insurance industry has launched microinsurance programs to serve communities at high risk from climate change. Microinsurance is designed for the world's most vulnerable populations, usually people earning less than $4 a day, to protect against the economic risks that can threaten their survival. Climate change is chief among these threats, especially for low-income farmers whose livelihoods are endangered by volatile weather patterns that disrupt crop production.

Conventional insurance models involve sophisticated marketing schemes, complex loss assessments, and a highly trained labor force. Microinsurance, on the other hand, eliminates these high transaction costs by using an index approach. The index approach (also known as parametric insurance) uses a pre-set, numeric measure to determine the severity of a natural disaster (such as total rainfall, the number of weeks in a drought, etc.). This measure is then used as the basis for allocating insurance payouts.[23] For example, if it rained more than 10 inches in one day, the microinsurance company would automatically compensate a farmer who's enrolled in the program. An index approach is cheaper and more objective than typical methods for evaluating insurance claims: insurance companies don't need to pay someone to evaluate damages (an individual is compensated automatically based on pre-set measures), and the pre-set threshold takes out the subjectivity of insurance allocation.

Microinsurance can provide financial security to populations typically underserved by traditional insurance schemes. In particular, it can help ensure the financial stability of people with fluctuating incomes dependent on the weather, such as fishermen or farmers. For example, a pilot program in Malawi offers a "microinsurance safety net" to farmers. This program allows farmers to take out a $35 loan, $25 for the cost of the seed, $2 for insurance, and the rest for the loan premium. If it rains (meaning the farmers have a good harvest), then the revenue from the crop should be larger than the loan, and the farmer can generate a profit. If the rains fail, then the farmers will be covered by insurance, and receive back the amount of the loan.[24]

The insurance industry is picking up on the large potential of microinsurance markets. According to the Insurance Information Institute, around 60 companies offer microinsurance, including AIG, Allianz, and Swiss Re.[25] Microinsurance coverage has expanded rapidly over the past decade, reaching almost 300 million people in 2017.[26] At the 2015 G7 Summit, political, nonprofit, private-sector, academic, and scientific leaders made a pledge to provide microinsurance to 400 million people from highly vulnerable populations by 2020.

Case Study: R4 Initiative Enhances the Resilience of Smallholder Farmers in Africa

The Rural Resilience (R4) Initiative is a partnership between the World Food Programme and Oxfam International, sponsored by the private reinsurance company Swiss Re. The program provides index-based crop insurance to farmers in Ethiopia, Senegal, Malawi, Zambia, and Kenya. Perilous food security in these regions is likely to be exacerbated by hotter temperatures and extended droughts connected to climate change. If current trends in climate change and agricultural production persist, some regions could experience a 30 percent reduction in per capita cereal production by 2025. The R4 Initiative takes a holistic approach to overcoming this challenge, and crop insurance is a crucial piece of it. Participating farmers pay their insurance premiums by working to build community resilience assets such as vegetable gardens, compost pits, dikes, and stone barriers. These assets both reduce the risks of crop failure in hard years, and enhance success in good years.[27]

Sovereign Risk Pools: Nations Sharing the Burden of Natural Disasters

A sovereign risk pool is an insurance instrument that covers multiple countries. Member countries share risks by paying premiums to the same 'pool' and receive payouts after disasters. Sovereign risk pools work according to the same principle as catastrophe bonds: by spreading the risks farther, they become more manageable. In this case, the risks each country faces are too significant for an individual country to manage. But when the countries share resources, they can cover their losses. Through the risk pool, members can obtain higher quality insurance for a lower cost. Diversifying risks lowers premiums and allows for shared operational costs, while scaling up gives members access to the international reinsurance market. There are three main sovereign risk pools: the African Risk Capacity in West Africa, Pacific Catastrophe Risk Assessment and Financing Initiative, and the Caribbean Catastrophe Risk Insurance Facility. Risk pools can also be implemented at the subnational level. Sovereign risk pools require significant political commitment from member countries and must be expertly designed in order to be financially sustainable, but when implemented effectively, they can be mutually beneficial for all members.[28]

Case Study: Caribbean Catastrophe Risk Insurance Facility

The Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC) is a sovereign risk pool with 17 members (16 Caribbean nations and Nicaragua). It provides index insurance for hurricanes, excess rainfall, and earthquakes. Since the pool was established in 2007, it has made 36 payouts of more than $130 million to countries in the CCRIF, and many smaller payouts. All payouts have been made within 14 days of the disaster event. These funds can be used to repair infrastructure, improve the resiliency of communities, or deliver humanitarian aid. After Hurricane Matthew in 2016, Haiti used about half of its CCRIF funds ($23 million) to provide medical aid, temporary shelters, and building materials for individual homes damaged during the storm. After Hurricanes Maria and Irma in 2017, Turks and Caicos used their CCRIF funds to repair schools.[29] Before CCRIF, most member countries depended heavily on international aid and loans for disaster relief, resources that could take months to mobilize. CCRIF is funded by membership fees and a Multi-Donor Trust Fund supported by the European Union, Canada, the Caribbean Development Bank, and others. It has the financial capacity to withstand multiple 1-in-10,000 year events within a single policy year.[30] CCRIF also offers microinsurance through a partnership with the Munich Climate Insurance Initiative (MCII).[31]

CCRIF is expanding to include new products to protect Caribbean fisheries and agriculture from the effects of climate change. In 2017, CCRIF began work on agricultural insurance models based on crop yield data from the UN's Food and Agriculture Organization (UNFAO). Index-based crop insurance could help Caribbean farmers whose livelihoods depend on the cultivation of banana, maize, coffee, rice, sugarcane and other tropical crops.[28] CCRIF – with the support of the U.S. State Department, UN Office for Disaster Risk Reduction (UNISDR), World Bank, UNFAO, and Nature Conservancy – is currently working on the development of the Caribbean Oceans and Aquaculture Sustainability Facility (COAST), a new organization devoted to protecting the food security of Caribbean fishing communities and enhancing coastal resilience.[32] The COAST program is "a parametric disaster risk insurance product" that combines risks across countries (similar to CCRIF) to protect primarily against hurricane damages – specifically, damages brought on by a five-year storm event.[33] The program is focused on the fishing industry and its infrastructure needs. CCRIF is involved in many other multi-stakeholder initiatives on climate change. For example, the CCRIF Small Grants Programme funds local-level, adaptation and risk reduction projects by community-based organizations (CBOs), non-governmental organizations (NGOs), and academic institutions.[28]

Insurance Industry Participation in Global Environmental Governance

The role of insurance in building financial resilience to climate change is codified in international climate law, including the Paris Climate Agreement. Article 8 of the Paris Agreement identifies "Loss and Damage" as a pillar of climate policy distinct from adaptation and recognizes the importance of insurance as a tool to address it.[34] Article 8 signals that financial resilience is a priority for national leaders and opens the door for future consideration of financial liability for climate change.[35]

The inclusion of Article 8 in the Paris Agreement is the most significant codification of insurance in a climate policy context to date, although not the first. Loss and damage was first formally considered by the United Nations Framework Convention on Climate Change (UNFCCC) in 2007 at the 13th annual Conference of the Parties (COP 13). The UNFCCC took action in 2013 by establishing the Warsaw International Mechanism for Loss and Damage (WIM), described as "the main vehicle in the UNFCCC process to address loss and damage associated with climate change."[36] The Mechanism's mission is to facilitate action on loss and damage, improve communication amongst stakeholders, collect and analyze information, and produce recommendations. The Paris Agreement clarified the role of WIM with a two-part mandate to create a clearinghouse for climate risk information and a new task force dedicated to the issue of displacement. WIM took a significant step toward implementing these mandates when it launched the Fiji Clearing House for Risk Transfer at COP 23 in 2017.[37]

The critical role of insurance in resilience building is also written into the Sendai Framework for Disaster Risk Reduction, an international agreement implemented by the United Nations International Strategy for Disaster Reduction (UNISDR).[38] The Sendai Framework provides extensive guidance on national and international risk management strategies. It builds on its predecessor, the Hyogo Framework for Action (2005-2015), calling on nations to implement seven disaster risk reduction targets through 2030. The Sendai Framework asserts that risk management is the responsibility of national governments, but encourages lawmakers to engage with the insurance industry to craft solutions. Industry engagement is particularly important for reducing disaster-related economic loss relative to GDP and increasing access to risk information and early warning systems.[38]

The industry has embraced its role as advisor and collaborator in the sphere of global environmental governance. The Munich Climate Insurance Initiative (MCII) is a nonprofit initiative that unites insurers, NGOs, and scientists to develop insurance-based solutions for climate risk management. MCII was initiated by Munich Re in 2005 and is hosted at the United Nations Institute for Environment and Human Security in Bonn, Germany.[39] MCII fills an important seat at the climate policy table and is recognized by both UNFCCC and UNISDR.[36] MCII has contributed to many pioneering projects on climate insurance including the G7-backed InsuResilience Initiative and the Climate Risk Adaptation and Insurance in the Caribbean project.[40]

This fact sheet is available electronically (with hyperlinks and endnotes) at *www.eesi.org/papers*.

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