UMD-GMU Boot Camp Policy Brief

Understanding Future Damage to Inform Climate Policy Action Today

James Rising, Ph.D.

School of Marine Science and Policy, University of Delaware

Key Messages for Policymakers

- Every ton of CO_2 released in the world today imposes about $360 in damages globally over the coming centuries. Current emissions levels result in $13.9 trillion in cumulative damages each year.
- These estimates account for the disproportionate impacts of climate change on marginalized groups globally and within countries; failing to account for impacts on marginalized groups underestimates total damages in many countries by 10 – 30%.
- The vast majority of damages in every country is attributable to emissions from outside that country, emphasizing the importance of international cooperation in climate policy.

Policy Context: The Global Cost of Climate Change

The impacts of climate change are increasing rapidly across the globe, with detrimental consequences for lives and livelihoods. Understanding who is at risk is crucial for accurately targeting interventions that can reduce these losses. Finance ministries, international financial institutions, and donor countries need a broad multinational perspective to fully understand climate risks (Rising et al. 2026).

This brief draws on a study that translates all of the impacts that are expected to be caused by climate change into economic losses. This estimate is commonly known as the "social cost of carbon" (SCC) and is expressed in dollars per ton of carbon dioxide emitted. The SCC is frequently used for cost-benefit policy analysis in a wide range of policy settings. In our study, the SCC is estimated at the national level to understand the how risks are distributed globally.

Research Findings: The Poorest Countries Face the Greatest Risks

Our estimate of the SCC from emissions in 2024 is $360 per ton of carbon dioxide, or $13.9 trillion in total per year. This estimate discounts the cost of climate change over time; damages imposed decades or centuries from now are considered far less costly than those experienced in the near term.

Each ton of CO_2 emitted, regardless of its source, results in a predictable pattern of damages across the globe. We find that the world's poorest countries face the greatest climate risks. Their reliance on outdoor labor and natural resources, and their exposure to high temperatures contribute to these risks. We also find that within countries, regardless of income level, poor populations are more vulnerable to climate change.

Figure 1 shows the estimated damages for the thirty largest countries that were caused by global emissions in 2024, expressed as a share of each country's economy in that year. The vast majority of these damages, even for the countries that produce the most greenhouse gases, such as the United States and China, are due to emissions from the rest of the world. This stark fact highlights the need for global coordination to address the climate problem.

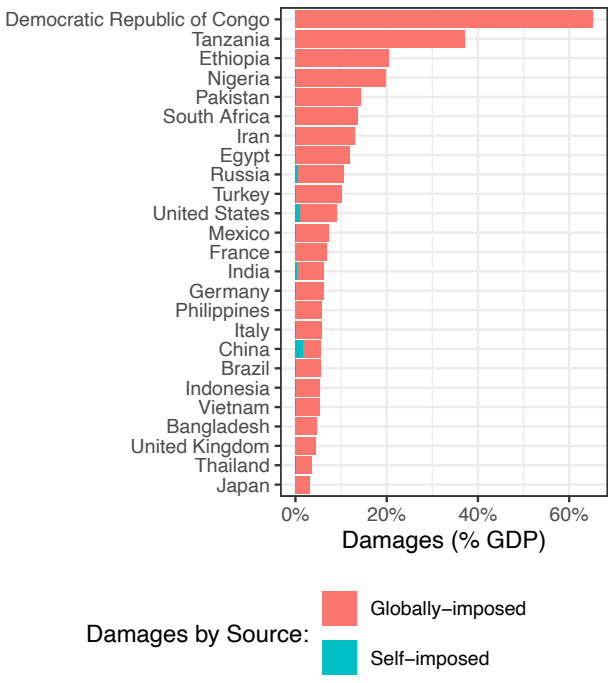

Figure 1: Cumulative Damages from 2024 Emissions

Most of the countries that will suffer the greatest damage are poor. The top six in Figure 1, notably, are all low- or lower middle income countries. These countries are the source of very few emissions. Practically all of their climate costs are imposed by other countries.

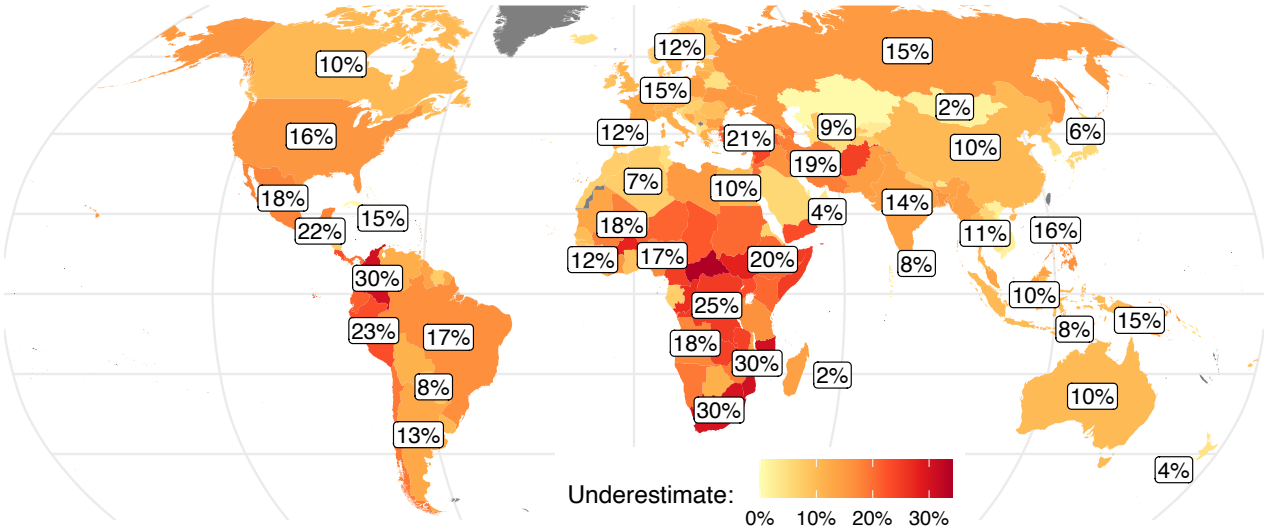

Figure 2: Underestimates of Climate Risk When Inequality Is Ignored

Inequality also shapes these costs. Countries with higher levels of economic inequality and larger vulnerable groups (such as those who have been uprooted, are food insecure, or have been affected by natural disasters) suffer higher losses. Such disparities have been ignored in most studies using methods similar to ours. Figure 2 shows their importance. The risks are underestimated by more than 30 percent in some Sub-Saharan African and the Middle Eastern countries. Even in higher-income countries, ignoring inequality leads researchers to underestimate climate damages by 10 – 20%.

Finally, in systems as complex as the climate and the economy, any estimates carry a considerable degree of uncertainty. Our model finds that there is a 25% chance that the damages will be over 3 times higher than the central values reported above. In fact, there is a 13% chance that the long-term damages caused by emissions today are equivalent to the entire output of the global economy.

Research Design: Improved Modeling

These results derive from an improved version of the widely-used PAGE model, which links together sophisticated representations of the climate and economy over the long run. SCC calculations account for the damages from CO_2 through 2300. We adopt discount rates used by the U.S. Environmental Protection Agency's 2023 update of the SCC.

Our improvements enable PAGE to represent most countries individually, as well as five small-island groups. We also deploy a suite of updates to climate, impact, and scenario modeling and a new method to estimate the risks to vulnerable groups within each country and across the income distribution.

Policy Implications:

Our estimate of the SCC exceeds the estimated costs of many emissions reduction policies. Adopting such policies would therefore avoid more damages worldwide than they would cost. The costs of many of these policies has declined over time as the costs of renewable energy fell, strengthening the case for them. Our research also shows that policies that reduce vulnerability for poor communities, helping them adapt to impacts that cannot be avoided, would be beneficial.

Finally, we highlight the need to redouble international cooperation. Policies adopted by the vast majority of countries benefit the rest of the world far more than themselves. The United States and China are the only exceptions; they could actually avoid more costs over the long term, due to their own emissions, than it would cost them to reduce emissions today. Self-interested action by these two countries, which would help the rest of the world as well, might induce greater international cooperation in the future.

Ancillary Materials:

Paper Reference:

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Acknowledgements: Rising was supported by Korea Environment Industry & Technology Institute (KEITI) through Climate Change R&D Project for New Climate Regime, funded by Korea Ministry of Environment (MOE) (RS-2023-00218794), and the 2024 Energy and Climate-Tech Innovation Policy Boot Camp hosted by George Mason University and the University of Maryland Center for Global Sustainability.
Competing Interests: None.