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POVERTY AND EQUITY GLOBAL PRACTICE

Climate and Equity: A Framework to Guide Policy Action

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Reducing the impact of climate change on poor and vulnerable households is essential to hastening poverty reduction. In thinking about policies that do this, it is useful to apply the same hazard, exposure and vulnerability framework that is often used to understand the physical impacts of climate change and add the non-climate benefits and costs to households that these policies can also bring. Policies that reduce hazards and vulnerability whilst bringing non-climate benefits—triple win policies—are not very common, but where possible they should be prioritized. Policies that reduce vulnerability and bring non-climate benefits are more common. However, some development policies that bring non-climate benefits, particularly in higher-income and higher-growth countries, may increase emissions by enough to worsen future hazards, so their emissions impact needs to be managed with compensating actions. Policies that reduce the hazards faced by poor households are needed, and the non-climate cost of these policies on poor people should be minimized or compensated where it cannot be avoided.

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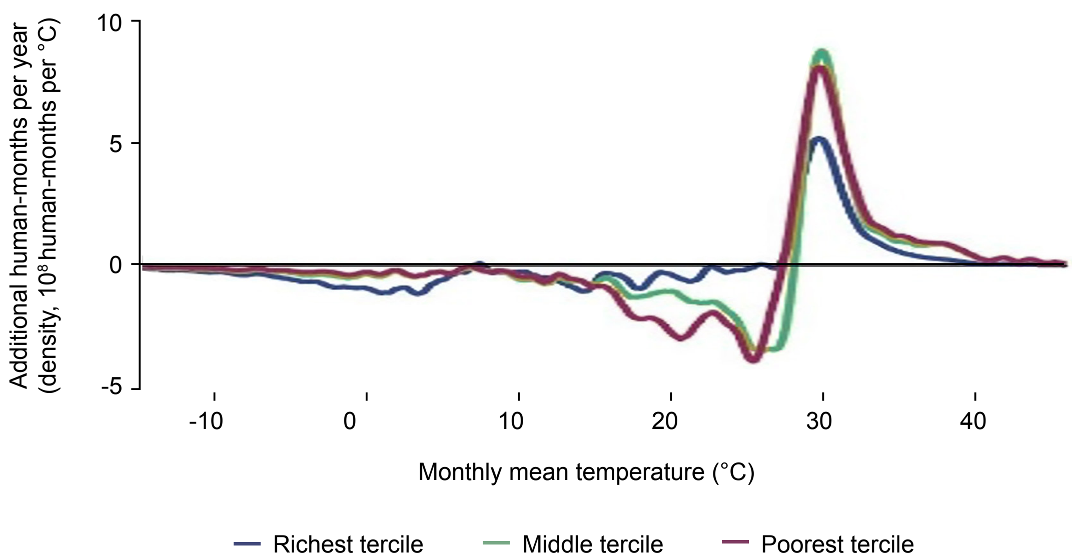
Poverty reduction and climate change are intricately linked

Lifting people out of poverty requires helping households to acquire and use capital—financial, physical, human, social, and natural—and ensuring that they earn a good return from it.[1] The livelihoods of poor households are often based on the use of natural capital, such as farming, pastoralism, or fishing. At the global extreme poverty line, 81 percent of households live in rural areas (compared with 51 percent of the population globally), and 62 percent are predominantly engaged in agriculture.[2]

Climate change, characterized by higher temperatures, rainfall extremes, and storms, alters the natural capital and thus especially affects the ability of poor people to earn an income. Unfortunately, these changes are projected to be more severe in places where there is more poverty (figure 1).

FIGURE 1 – Higher temperatures will affect the world's poorest



Source: Hsiang, Oliva, and Walker 2019.
Note: Graph shows changes in the amount of time the global population is exposed to temperatures arising from "business as usual" warming by 2100 for terciles of the global income distribution.

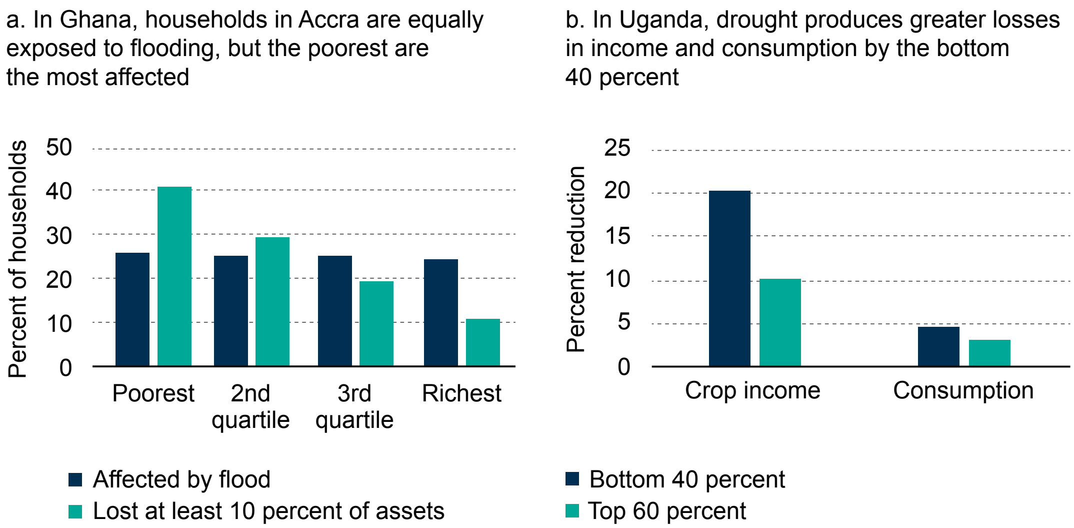
This is not the only reason why climate change is particularly challenging for poor households. The lack of capital that accompanies a life in poverty makes hazards more costly. Inadequate insulation, lack of weatherproofing, and substandard construction materials are common characteristics of houses inhabited by poor households, rendering them more susceptible to weather extremes (figure 2, panel a). Because poor people often live in remote

[1] Lopez-Calva and Rodríguez-Castelán 2016
[2] World Bank 2020, 2022b

locations, the prices of the goods they buy are more likely to be affected by local weather events. They are less likely to be able to rely on savings, access to credit, or insurance to manage their losses of income or assets (figure 2, panel b); less likely to be covered by social insurance; and less likely to be able to switch to other livelihoods because of low levels of education, financial resources, and market access. As a result, poor households often cope with shocks by depleting the few assets they hold, which turns temporary shocks into permanent losses.

The subtler welfare impact occurs not when disasters strike but in the costly behavior driven by the anticipation of shocks that households are ill-placed to cope with. Although quieter, in some contexts, this can be the larger constraint to accelerating poverty reduction. One study found this to be twice as large an impact on income growth, and ten well-identified studies across contexts show that when households have better access to climate risk management instruments, there is a 15-30 percent increase in investment regardless of whether shocks occur.[3]

FIGURE 2 – Climate hazards are costlier for those at the bottom of the income distribution



Source: Panel a: Erman et al. 2018; panel b: World Bank 2016.

The "hazard, exposure, and vulnerability" framework

Reducing the impact of climate change on poor and vulnerable households is essential to hastening poverty reduction. When it comes to thinking about policies that do this, it is useful to use the same hazard, exposure and vulnerability framework that is used to understand the physical impacts of climate change.[4] Figure 3 summarizes this framework. The hazard is the negative climate-related event that affects people based on where they

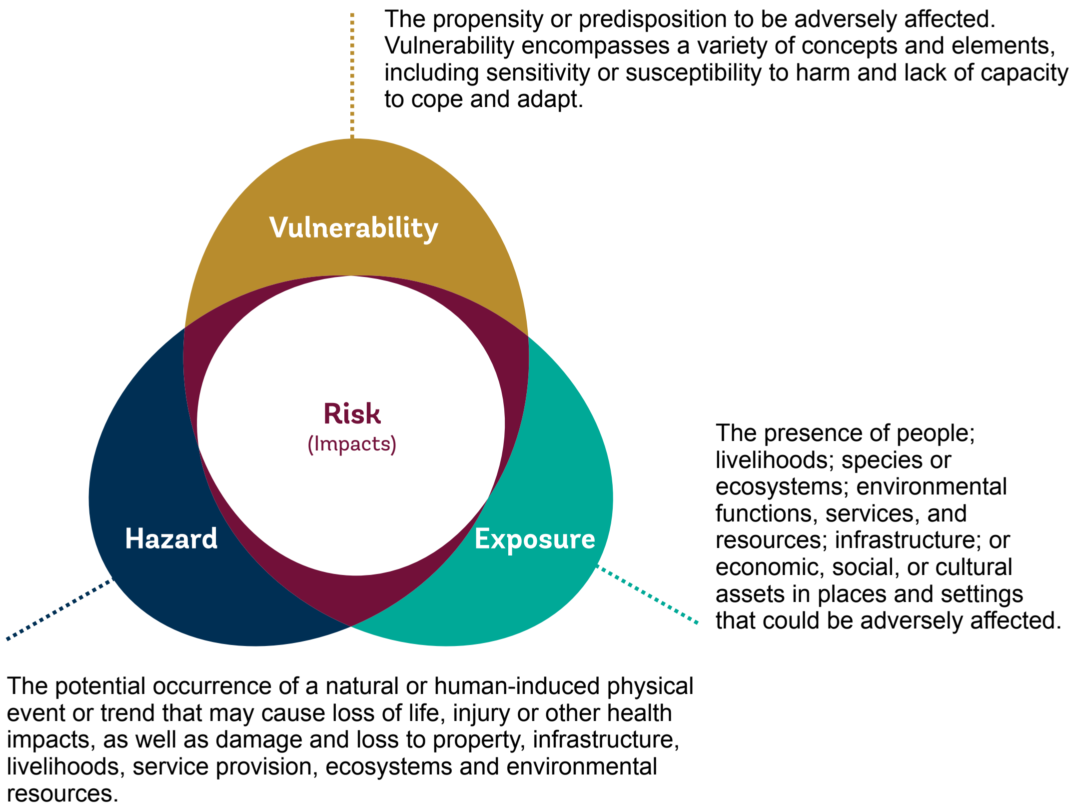
[3] Elbers, Gunning, and Kinsey (2007) on growth impact. Ten well-identified studies: Mobarak and Rosenzweig (2013) for rainfall index insurance in India; Elabed and Carter (2014) for area yield insurance in Mali; Karlan et al. (2014) for rainfall index insurance in Ghana; Cai et al. (2015) for swine insurance in China; Cai (2016) for area-yield insurance in China; Fuchs and Wolff (2016) for rainfall index insurance in Mexico; Jensen et al. (2017) for livestock insurance in Kenya; Hill et al. (2019) for rainfall and area yield insurance in Bangladesh; Stoeffler et al. (2020) for area yield in Burkina Faso; Bulte et al. (2020) for multiperil crop insurance in Kenya.
[4] IPCC 2022

live (exposure). Vulnerability captures how much a given negative weather event affects a household's income or well-being. As noted, poor households are particularly vulnerable to weather hazards because they disproportionately rely on natural capital to earn income and because their lack of other assets makes it much harder to manage the impacts of a weather hazard.

Policies are needed in each of these areas. The probability distribution of hazards in the future can be altered through mitigation policies. An example is carbon taxes, which reduce emissions, particularly in high-emitting countries.[5] However, other policies, such as those that encourage increasing tree cover, can also bring more immediate changes in local weather conditions.[6]

Exposure can be altered by policies that enable households to move themselves or their assets to locations less affected by hazards. Policies that change a household's vulnerability to hazards range from those focused on adaptation, such as encouraging households to invest in water management and soil quality or in better-quality housing, to more general development policies that increase the capital of poor households, thereby allowing them to better cope with climate shocks or earn more income from activities less affected by hazards. For example, increasing the quality of education, building better roads that connect households to markets, improving city planning, adopting early warning and evacuation systems, or facilitating financial inclusion can all contribute to reducing a household's vulnerability.

FIGURE 3 – Understanding climate impacts: The hazard, exposure, and vulnerability framework



Source: IPCC AR5/6

[5] For example, see Rafaty et al. (2021); for Europe, Lin and Li (2011); for the United Kingdom, Martin, de Preux, and Wagner (2014); for Canada, Rivers and Schaufele (2015) and Metcalf (2019); and for Sweden, Andersson (2019).
[6] See, for example, Harlan et al. (2006), Schwaab et al. (2021), and Ziter et al. (2019).

Conceptualizing the welfare impacts of policy actions

With this framework in mind, one could conceptualize the welfare impacts of climate actions as the benefits arising from improvements in the probability distribution of hazards or as a reduction in exposure and vulnerability.

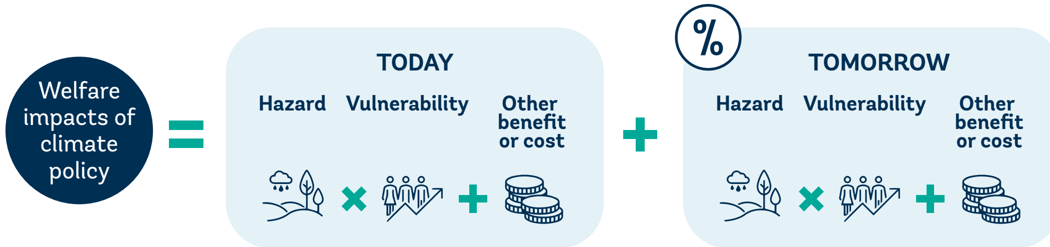
Climate actions can also have welfare implications beyond this framework about climate impacts. They could carry a cost or bring an additional benefit that directly impacts welfare. This could be an actual cost to households or a cost in terms of opportunity cost when money is not used for other purposes. For example, carbon pricing may reduce the net return earned from carbon-intensive livelihoods and so, in the absence of policies that enable a transition to renewable energy or revenue recycling, may hurt welfare. Similarly, carbon border adjustment taxes in one country or region could reduce exports from, and thus the earnings on, the affected production activities in other countries or regions. In addition, in view of constrained public resources, financing the investments in green technologies or spending on disaster recovery could come at the cost of reducing resources for human capital development or infrastructure improvements. However, climate actions can also bring benefits. For example, investments in health can reduce vulnerability to climate shocks and increase an individual's productive capacity and income.

Figure 4 summarizes the welfare impacts of a climate policy on an individual through three main channels: hazards, vulnerability, and other benefits or costs to households. In the figure, changes in a household's exposure and vulnerability are labeled simply *vulnerability* for ease of exposition. The valuation of any policy will vary across people, and it cannot be assumed that the impacts on hazards and vulnerability or other direct effects on welfare are uniform across a population. Some households may experience large welfare gains from a climate action, while for others the gains could be smaller, especially if the cost to these individuals is high. The total social welfare impact of a policy on a society will be the sum of the welfare impacts on each person across the welfare distribution, taking into account social welfare weights.

FIGURE 4 – **Welfare impacts of a climate policy**

The benefits of policy actions are often realized long after investments are made. The timing of policy costs on households can be different, especially where policies increase prices or require upfront investments but only yield benefits—even if large—later. A policy has an impact in the near term (*today* in figure 5), but also in the longer term (*tomorrow* in figure 5). The overall welfare impacts will take both into account. The full beneficial impacts of climate actions on hazards is realized over the long run, whereas the costs of climate actions are more likely to be felt in the near term. However, future benefits are discounted when they are valued today. The valuation of today *versus* tomorrow largely depends on individual circumstances. There can be trade-offs across different time periods or generations and among different groups of people.

FIGURE 5 – **The welfare impacts of climate policy: taking timing into account**



Prioritizing triple wins for the poor

This framework underscores that policies with positive welfare impacts through all three channels should be prioritized. These are policies that reduce vulnerability, positively impact future hazards, and also generate income for households typically at the bottom of the global or country income distributions.

Although there are often trade-offs, such "triple win" policies do exist. For example, in the Sahel farmers use low-cost, efficient traditional practices, such as agroforestry and conventional rainwater harvesting techniques, to capture rainfall, reduce runoff, and restore soils. Soils play an important role as passive agents in removing atmospheric carbon dioxide.[7] Rainwater harvesting and agroforestry have been shown to increase soil carbon sequestration at the estimated rates of 839 and 1,359 kg of carbon per hectare per year $C.ha^{-1}.yr^{-1}$, respectively, in Africa.[8] The resulting higher organic content in the soil increases yields and allows farmers to reduce their reliance on chemical fertilizers, further contributing to climate mitigation. In Niger, these practices were found to increase yields,[9] which is consistent with the findings of older studies that showed that yields were 16–30 percent higher for farmers implementing these techniques in Niger, with similar yield gains in Burkina Faso.[10] These practices also reduce vulnerability to low rainfall, allowing yield increases in low rainfall years.[11] Training increases adoption of these practices, and trained farmers then inform their neighbors. As a result, trained farmers are 50 percent more likely to have neighbors adopting the technique than farmers who are not trained.[12] This finding suggests that training is a cost-effective way to boost the adoption of profitable and accessible technologies. Further investment in identifying policies that bring triple wins for households at the bottom of the income distribution across contexts is needed.

[7] Manning 2008
[8] World Bank 2012
[9] Aker and Jack 2021
[10] Matlon 1985
[11] Baquie and Hill 2023
[12] Aker and Jack 2021

Using policy packages to manage trade-offs where they exist

Often, however, there are trade-offs across the three channels of impacts, across time or generations, and across groups of people. When they do emerge, it is important to understand them and then manage them by considering policy packages. This section highlights two types of trade-offs: (1) policies that reduce vulnerability and increase income growth for poor households—double wins as it were—but could worsen emissions and hazards, and (2) cross-generational trade-offs for poor people.

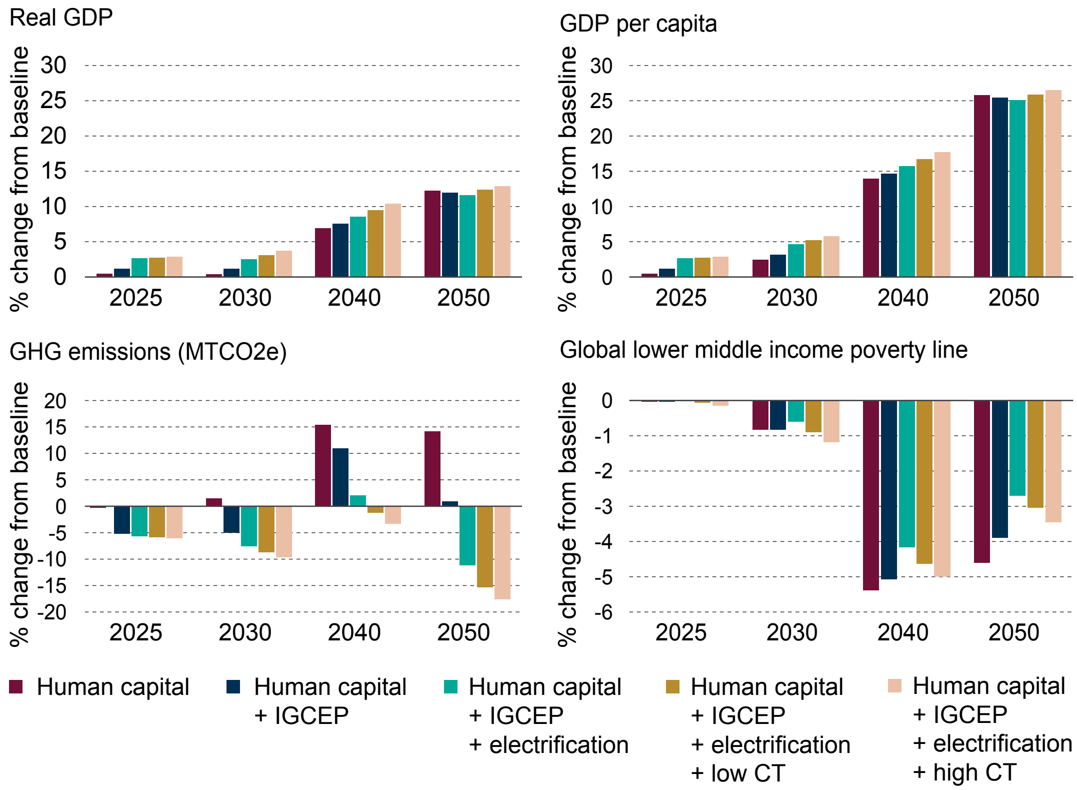
Reducing vulnerability, growing incomes, but increasing emissions

Many policies that increase the ability of households to earn income also reduce the impact of extreme climate events on welfare. For example, mobile money spurs development, thereby increasing welfare.[13] When a weather crisis strikes, it also allows households to quickly receive transfers or remittances quickly from relatives or migrant family members who live elsewhere.[14] Similarly, better access to roads in remote areas increases access to markets, goods, and services, thereby bringing development. When drought reduces local food availability, improved access to markets reduces the impact of this weather shock on local food prices.[15] Education increases a household's ability to earn income, but it also allows households to switch sectors when climate shocks reduce returns in the sector in which they are engaged.[16] None of these policies and similar policies would be considered adaptation investments designed to reduce the vulnerability of households to climate events, but they can be highly effective in reducing vulnerability.

It is important to note, however, that without actions to reduce the carbon footprint of goods and energy consumed in a country, development policies, like many growth-enhancing policies, can increase emissions. At low levels of growth or for very poor countries, growth in emissions may have a negligible impact on the hazard distribution in the future, but for higher growth rates or for middle-income countries, the growth in emissions is large enough to worsen the hazard distribution in the future at a faster rate.[17] Commensurate climate actions will be needed. This is explored in the *Pakistan Country Climate and Development Report.*[18] Figure 6 from this report shows that human capital investments have a large impact on growth and poverty reduction, but they increase emissions when implemented unless accompanied by climate actions to shift energy production to renewable resources and reduce the consumption of carbon. When human capital investments are implemented with policies that shift energy production to renewable resources and increase the cost of carbon, growth and poverty impacts are sustained and emissions fall.

[13] Batista and Vicente, forthcoming
[14] Jack and Suri 2014
[15] Burgess and Donaldson 2010
[16] Hill and Mejia-Mantilla 2017
[17] Wollburg et al. 2023
[18] World Bank 2023

FIGURE 6 – Growth, emissions, and poverty impacts of investment in human capital on GDP, greenhouse gas emissions, and poverty (with and without a shift to sustainable energy policies), 2025–50



Source: World Bank 2023.

Note: CT = carbon tax and revenue recycling; GDP = gross domestic product; GHG = greenhouse gas; IGCEP = indicative generation capacity expansion plan; MTCO2e = million tonnes of carbon dioxide equivalent. Electrification refers to the accelerated shift to renewable sources of energy for production and domestic consumption. Human capital policy refers to (1) reducing child malnutrition to under 5 percent by 2030 by expanding access to safe water and sanitation (as per Sustainable Development Goal 6) to all households that currently lack access; and (2) accelerating the fertility decline to replacement levels. Under the modeled scenario, the total fertility rate drops to 2.0 by 2035 and then remains constant at 2.0 until 2050. Under business as usual, total fertility drops to 3.0 between 2030 and 2040 and to 2.0 by 2050.

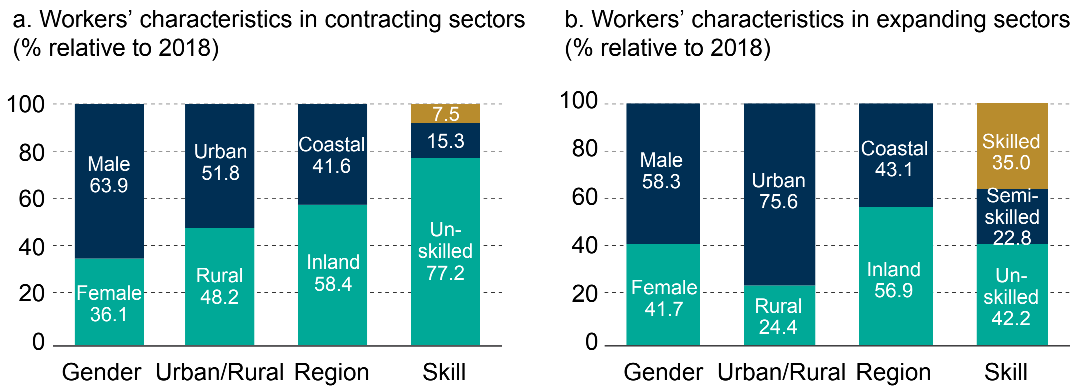
Cross-generational trade-offs for poor people

Although some policies focused on altering the probability distribution of hazards can have quite immediate benefits, many will have benefits in the future. Because these policies have a cost now, there is a trade-off between paying now (whether in monetary terms or in growth foregone) and future benefits. That trade-off is different for different people.

The improved hazard distribution is often shared across people in a given location, but the cost can be different for different people in the same location. For example, the cost of switching from coal to solar energy is larger for a person who works in a coal mine. According to the *China Country Climate and Development Report*, the profile of people in sectors that contract with climate action will be very different from the profile of those in sectors that expand with climate action (figure 8).[19] Also, importantly, for a given cost, the trade-off is larger for poorer people because the marginal utility of an extra dollar of income is higher at lower levels of income, and future benefits are often discounted at a higher rate.

[19] World Bank 2022a

FIGURE 8 – Workers in contracting sectors have a different profile (low-skilled males working inland) than workers in expanding sectors (high-skilled males working in coastal urban areas)



Source: World Bank calculations based on computable general equilibrium (CGE) modeling results in 2030 relative to 2018, combined with the average sector characteristics based on the 2018 China Family Panel Survey house survey data. Sector characteristics are held fixed at their 2018 levels.
Note: Graphs are showing the distribution of jobs lost and gained, holding job characteristics fixed.

These findings have two implications: (1) reductions in hazards should be achieved with policies that impose the least cost on poor people in the present; and (2) where costs on poor people are unavoidable, they should be compensated with instruments that address the intertemporal trade-off. Ideally, the goal should be to identify a policy mix of climate mitigation policies accompanied by compensatory actions that would increase the benefits for poor people today or tomorrow while minimizing the costs. For example, revenue from carbon taxes could be recycled not only to targeted transfers but also to productive investments such as in reskilling and upskilling, facilitating mobility, and reducing market frictions and credit market failures. Such investments actively support poor households in transitioning rather than just compensating them for losses.

Importantly, this framework can also inform discussions of tradeoffs and policy packages at the global level. Policies in one country (or political unit) can impact the probability distribution of hazards in another. Certainly, the overconsumption of carbon in high-income countries has adversely altered the probability distribution of hazards in low- and middle-income countries, causing the problem the world collectively faces today. Policies in high- and upper-middle-income countries, paid for by the people in those countries, have the potential to bring benefits for poor people living in low- and middle-income countries by positively impacting the distribution of hazards they face.

To manage trade-offs, the same logic underlying the compensation of poor people within countries can be considered when it comes to compensating or supporting poor countries. Reductions in hazards should be achieved with policies that have the least cost for poor countries, and where costs on poor countries are unavoidable, they should be compensated with effective instruments that address the intertemporal trade-off.

References

Aker, Jenny C., and Jack Kelsey. 2021. "Harvesting the Rain: The Adoption of Environmental Technologies in the Sahel." NBER Working Paper, National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w29518.

Andersson, Julius J. 2019. "Carbon Taxes and CO_2 Emissions: Sweden as a Case Study." American Economic Journal: Economic Policy 11 (4): 1–30.

Baquie, Sandra, and Ruth Hill. 2023. "Real-World Policies for a Low-Carbon Future (Improving Water Availability and Restoring Soil Fertility in the Sahel)." World Bank, Washington, DC.

Batista, C., and P. Vicente. Forthcoming. "Is Mobile Money Changing Rural Africa? Evidence from a Field Experiment." Review of Economics and Statistics.

Burgess, R., and D. Donaldson. 2010. "Can Openness Mitigate the Effects of Weather Shocks? Evidence from India's Famine Era." American Economic Review: Papers and Proceedings 100 (May): 449–53

Erman, A., E. Motte, E. R. Goyal, A. Asare, S. Takamatsu, X. Chen, S. Malgioglio, et al. 2018. "The Road to Recovery: The Role of Poverty in the Exposure, Vulnerability and Resilience to Floods in Accra." Policy Research Working Paper 8469, World Bank, Washington, DC.

Harlan, S. H., A. J. Brazel, L. Prashad, W. L. Stefanov, and L. Larsen. 2006. Neighborhood Microclimates and Vulnerability to Heat Stress. Social Science and Medicine 63 (11): 2847–63. https://doi.org/10.1016/j.socscimed.2006.07.030.

Hill, R. V., and C. Mejia-Mantilla. 2017. "With a Little Help: Shocks, Agricultural Income, and Welfare in Uganda." Policy Research Working Paper 7935, World Bank, Washington, DC.

Hsiang, S., P. Oliva, and W. R. Walker. 2019. "The Distribution of Environmental Damages." Review of Environmental Economics and Policy 13 (1): 83–103.

IPCC (Intergovernmental Panel on Climate Change). 2022. "Climate Change 2022: Impacts, Adaptation and Vulnerability." IPCC, Geneva.

Jack, William, and Tavneet Suri. 2014. "Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution." American Economic Review 104 (1): 183–223.

Lin, Boqiang, and Xuehui Li. 2011. "The Effect of Carbon Tax on Per Capita CO2 Emissions." Energy Policy 39 (9): 5137–46.

Lopez-Calva, L.F. & Rodríguez-Castelán, C. 2016. Pro-Growth Equity; Pro-Growth Equity: A Policy Framework for the Twin Goals: A Policy Framework for the Twin Goals. Policy Research Working Paper No. 7897. World Bank, Washington, DC.

Manning, D. A. C. 2008. "Biological Enhancement of Soil Carbonate Precipitation: Passive Removal of Atmospheric CO_2." Mineralogical Magazine 72 (2): 639–49.

Martin, Ralf, Laure B. de Preux, and Ulrich J. Wagner. 2014. "The Impact of a Carbon Tax on Manufacturing: Evidence from Microdata." Journal of Public Economics 117: 1–14.

Matlon, P. J. 1985. Annual Report of ICRISAT/Burkina Economics Program. Ouagadougou, Burkina Faso: International Crops Research Institute for the Semi-arid Tropics (ICRISAT).

Metcalf, G. 2019. "On the Economics of a Carbon Tax for the United States." Brookings Papers on Economic Activity, Brookings Institution, Washington, DC.

Rafaty, R., G. Dolphin, and F. Pretis. 2021. "Carbon Pricing and the Elasticity of CO2 Emissions." Working Paper 21-33, Resources for the Future, Washington, DC.

Rivers, Nicholas, and Brandon Schaufele. 2015. "Salience of Carbon Taxes in the Gasoline Market." Journal of Environmental Economics and Management 74: 23–36.

Schwaab, J., R. Meier, G. Mussetti, S. Seneviratne, C. Bürgo, and E. L. Davin. 2021. "The Role of Urban Trees in Reducing Land Surface Temperatures in European Cities." Nature Communications 12: 6763. https://doi.org/10.1038/s41467-021-26768-w.

Wollburg, Philip Randolph, Stephane Hallegatte, and Daniel Gerszon Mahler. 2023. "The Climate Implications of Ending Global Poverty." Policy Research Working Paper 10318, World Bank, Washington, DC.

World Bank. 2012. Carbon Sequestration in Agricultural Soils. Washington, DC: World Bank.

World Bank. 2016. "Uganda Poverty Assessment." World Bank, Washington, DC.

World Bank. 2020. Poverty and Shared Prosperity Report 2020: Reversals of Fortune. Washington, DC: World Bank.

World Bank. 2022a. China Country Climate and Development Report. Washington, DC: World Bank.

World Bank. 2022b. Poverty and Shared Prosperity Report 2022: Correcting Course. Washington, DC: World Bank.

World Bank. 2023. Pakistan Country Climate and Development Report. Washington, DC: World Bank.

Ziter, C. D., E. J. Pedersen, C. J. Kucharik, and M. G. Turner. 2019. "Scale-Dependent Interactions between Tree Canopy Cover and Impervious Surfaces Reduce Daytime Urban Heat during Summer." Proceedings of the National Academy of Sciences 116 (15): 7575–80. https://doi.org/10.1073/pnas.1817561116.

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