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# Climate Shocks and the Poor

## A Review of the Literature

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## Abstract

There is a rapidly growing literature on the link between climate change and poverty. This study reviews the existing literature on whether the poor are more exposed to climate shocks and whether they are more adversely affected. About two-thirds of the studies in our analyzed sample find that the poor are more exposed to climate shocks than is the rest of the population and four-fifths of the studies find that the poor are more adversely affected by climate shocks than is the rest of the population. Income and human capital losses tend to be concentrated among the poor. These findings highlight the potential long-term risk of a climate-change induced poverty trap and the need for targeted interventions to protect the poor from the adverse effects of climate shocks.


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# Climate Shocks and the Poor: A Review of the Literature[*]

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## 1. Introduction

Climate shocks are expected to become more frequent and more intense as climate change continues (United Nations Framework Convention on Climate Change 2007). Those shocks will cause widespread economic and social damage. Among those who could be hurt the most are the poor. Studies are increasingly focusing on how climate change affects those in poverty. The objective of this study is to systematically review and synthesize the existing literature on the distributional impact of climate change, focusing on poor households. Specifically, this study reviews the literature to examine two questions: Are the poor more exposed to climate shocks and are they more adversely affected by climate shocks.

Poor households may be more exposed to climate shocks than non-poor households for several reasons: First, poor households often reside or work in locations that are prone to climate shocks—in part because they have fewer options than better-off households. Second, poor households may face a more difficult tradeoff between locational amenities, including climate risks and proximity to income-earning opportunities (Kim 2012; Hallegatte et al. 2016).

Even if poor and non-poor households are equally exposed to climate shocks, poor households could be disproportionately harmed by climate shocks because they may have fewer resources to invest in protection against climate risks, resulting in a larger loss of their income or assets; have lower-quality housing and infrastructure; be less able to respond to shocks after they occur; or have less access to post-disaster relief mechanisms than non-poor households (Anttila-Hughes and Hsiang 2013; Hallegatte, Fay, and Barbier 2018). As a result, climate shocks can keep households in poverty for prolonged periods (Carter et al. 2007). A better understanding of exposure to these environmental shocks and their effects on the poor can shed light on the burden of climate change and how policies can help.

There is a large and rapidly growing literature on the relationship between climate change and poverty. This study updates previous literature reviews (Hallegatte et al. 2020; Hallegatte et al. 2016), and incorporates quantitative estimates of all 37 recently published *Country Climate and Development Reports* (CCDRs) from the World Bank. Previous literature reviews have described groups of studies in detail (Hallegatte, Fay, and Barbier 2018), or examined specific channels through which poor households are more affected, such as physical infrastructure (Hallegatte,

Rentschler, and Rozenberg 2019). In contrast, this study aims to offer broad coverage across various contexts by covering the literature comprehensively, although in less detail.

Hallegatte et al. (2016) use a framework that distinguishes between households' (or countries') exposure, vulnerability, and resilience to shocks. *Exposure* refers to the likelihood a household (or country) will experience a climate shock. *Vulnerability* is the likelihood a household (or country) will be harmed by a climate shock. *Resilience* measures a household's (or country's) ability to withstand the effects of a climate shock. Unfortunately, only a few papers in our sample provide estimates on resilience, so this study combines vulnerability and resilience into a single category to assess the impact of shocks after they materialize.

Our sample came from backward and forward citation searches from 11 index studies, three databases, and a recent review on climate adaptation (Rexer and Sharma 2024). The analyzed sample includes 701 estimates from 70 studies.

About two-thirds of the estimates within the analyzed sample show that poor households are significantly more exposed than other households. The disproportionate impact on poor households has been extensively documented, and our findings are consistent with the literature, especially for income and human capital losses. The evidence for other impacts is mixed. These findings have important implications for policy and practice, highlighting the need for targeted interventions to protect poor households from the adverse effects of climate shocks.

The remainder of this study is structured as follows: Section 2 describes the data and methodology used for the meta-analysis. Section 3 presents the results. Section 4 four discusses policy implications.

## 2. Data and method

### *2.1 Data*

A meta-analysis typically begins with a citation search of at least two databases complemented by other sources such as expert recommendations or index studies—followed by title and abstract screening, full text screening, and finally meta-analysis regressions. Our citation search began with 11 index articles we previously identified, followed by backward and forward citations searches—

which produced 3,093 studies. The search was complemented by a database search. The keyword search in the databases generally aimed to look for the "poor's exposure to natural disasters" and the "impact of natural disasters on the poor." The database searches produced an additional 880 studies: 80 studies from *Scopus*, 320 studies from CORE, and 450 studies from *Jstor*.[2] After duplicate citations were removed, 1,303 articles and reports remained. We also complemented our search with studies in a review of climate adaptation by Rexer and Sharma (2024). Citation results were restricted to those in English, published in the field of economics or general-interest peer-reviewed journals, and reports published between 2000 and 2023.[3] The list of journals was based on the list developed by Rexer and Sharma (2024). These restrictions excluded 518 studies, leaving 785 studies for abstract screening.

In our search, "poor" refers to poor households, poor regions, or poor countries. This broad definition allows us to capture a wide range of studies that examined the distributional impacts of climate change at different levels of analysis. An artificial intelligence (AI) model, GPT4-32k, was used to screen abstracts for climate shocks. We conducted a validation test on the AI output by comparing a reviewer's binary coding with the AI output and reached agreement in 87.2 percent of the validation sample. We then used the AI response to filter the remaining abstracts, leaving 361 abstracts for further review. Two reviewers then excluded 272 studies because they did not analyze the poor's exposure to climate shocks or the impact of such shocks on the poor. Conflicts in inclusion and exclusion at this stage were reconciled by a third reviewer to yield 89 studies for the full text screening stage. Each study was then examined by two reviewers. Studies were excluded if they did not analyze the poor's exposure to climate shocks or compare the impact of such shocks on the poor relative to the non-poor. Conflicts at this stage were reconciled by a third reviewer to yield 70 studies and 701 regression results for the analysis. Figure 1 describes the number of studies at each screening stage.

[2] The keyword search in *Scopus* included 'natural disaster' and 'poverty' in the fields of Economics and Econometrics. The keyword search in CORE included 'effect of natural disaster' and 'poor' in the field of Economics. The keyword search in *Jstor* included 'natural disaster' and 'poverty' in the field of Economics. The item type in each database was restricted to articles. The search in *Scopus* and *Jstor* was done on November 14, 2023 and the search in CORE was done on November 15, 2023.

[3] While it is possible to examine studies from before 2000, we believe more recent studies would be more similar to current policy settings.

The studies in our sample exhibit considerable variations in the outcomes examined as well as the definitions of outcomes, shocks, and the level of analysis. To compare studies that examine different outcomes, we constructed two binary indicators from each estimate: first, "are the poor more exposed to climate shocks," and second, "are the poor more adversely affected by climate shocks." The first takes the value 1 when the poor are found to be more exposed to climate shocks and 0 otherwise. Similarly, the second indicator takes the value 1 when the poor are found to be more adversely affected by climate shocks and 0 otherwise. We included estimates with dependent or independent variables or sample restrictions related to poverty, poor and the level of wealth. Studies that document that the poor are adversely affected by climate shocks but do not compare the effect of such shocks on the poor and non-poor were excluded from the analyzed sample. This approach allowed us to identify studies that separate the effect of climate shocks on the poor from the effect on the rest of the population. Our sample included observational studies, simulations, and studies using quasi-experimental methods—experimental evidence on this topic is not available. By including a diverse range of methodological approaches, we aim to provide a comprehensive synthesis of the existing literature on the distributional impacts of climate shocks.

The events include climate change, natural disasters, temperature changes, heatwaves, typhoons, rainfall, floods, droughts, earthquakes, and landslides. We then created indicator variables for each of these climate events. In the analysis, we focused on flood, drought, extreme heat, cyclones, or typhoons—because these events have been widely studied in the literature. We also included earthquakes because their occurrence is uncorrelated to climate change and global warming, serving as an exogenous variable that could be used to compare results, a practice widely adopted in the literature (Kahn 2005). We also included climate change as an all-encompassing event for all climate shocks because many studies only analyze the broad impact of climate change without references to specific climate shocks.

Our sample has wide geographic coverage. It includes 116 countries and regions out of the 195 countries and regions in the world. This wide coverage ensures that our analysis captures the diversity in the distributional impacts of climate shocks in different geographical settings. Studies in our sample use data at various levels of aggregation—country, sub-national, household, and individual.

*2.2. Estimation strategy*

A probit regression is used to estimate the probability of a study estimate finding that the poor are statistically significantly more exposed to, or adversely affected by, specific climate shocks:

$$p_i = \Phi(\beta_1 \sum Type_i + \beta_2 \sum Region_i + \beta_3 \sum LevelOfAnalysis_i),$$

where $p_i$ is an indicator that takes the value 1 if estimate $i$ shows that the poor are more exposed to (or more adversely affected by) climate shocks. $Type$ includes indicators for climate change, heat, flood, drought, and an excluded category of all other natural disasters and pollution; *Region* includes indicators for the United States, sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America and Caribbean, Europe and Central Asia, Middle East and North Africa, and an excluded category for global or multi country studies; *LevelOfAnalysis* includes sub-national, household, individual, and an excluded category of country level analysis. The estimates were clustered at the study level. The marginal effects calculated at the mean are reported for ease of interpretation.

The analysis for adverse effects on the poor also considers the channels through which the poor may be adversely affected. The same model is estimated with the addition of indicator variables for the following outcomes considered by the studies: declining income, human capital losses, and all other outcomes. Income includes household or individual income, household or individual earnings, household expenditure, and household consumption. Human capital outcomes include health, education, crime, and food security. Other outcomes include mortality, welfare, productivity, and growth.

## 3. Results

*3.1 Sample characteristics*

Our sample includes global, regional, and country-specific studies.[4] About 16 percent of the studies use global data or data from multiple countries, 24 percent are on sub-Saharan Africa, 17 percent are on East Asia and Pacific, 13 percent are on South Asia, 10 percent are on Latin America

[4] Countries are categorized into regions based on the World Bank's regions (https://data.worldbank.org/country).

and the Caribbean, 7 percent each are on Europe and Central Asia and Middle East and North Africa, and 6 percent are on the United States (Table 1). The geographic distribution is broadly similar for estimates on the poor's exposure to climate shocks and the more adverse impact of such shocks on the poor (Table 2).

The majority of studies (57 percent) in our sample focus on general climate change, followed by studies on temperature anomalies (about one third), flooding, droughts, and general natural disasters (about one fifth each), and less than 10 percent of studies focusing on landslides, typhoons/cyclones, or earthquakes (Table 1). These indicators are not mutually exclusive since some studies examine multiple shocks. About one fifth of studies focus on heat, a subset of studies on temperature anomalies. Almost a quarter of estimates in our sample focus on the poor's exposure to floods, and about a third focus on the more adverse impact of climate shocks on the poor (Table 2). The share differences at the study and estimate levels reflect the estimates from multiple specifications documented in the studies.

We assess the representativeness of the studies in our sample against the reported incidence of regional climate shocks in the global EMDAT (Emergency Events Database) database by performing a two-proportion t-test. EMDAT is a comprehensive global database that collects and provides information on the occurrence and effects of more than 22,000 mass disasters worldwide since 1900. The database includes information on natural disasters (geophysical, meteorological, hydrological, climatological, biological, and extraterrestrial) and technological disasters (industrial, transport, and miscellaneous accidents). The database includes disasters in which 10 or more people died, 100 or more people were affected, a state of emergency was declared, or international assistance was provided. We used EMDAT data from 2000 to 2023 from each region in the world for comparison (Table 3).[5] We find that, in our sample, the share of studies on sub-Saharan Africa is similar to the reported incidence of climate shocks in EMDAT. The share of studies on South Asia is higher than the reported incidence of shocks. Other regions are under-represented. The results show that the coverage for floods and heat are lower in our sample, while it is higher for droughts in our sample of studies relative to the reported incidence in EMDAT.

[5] Last accessed November 28, 2023.

These differences across shocks and regions in our sample relative to the reported incidence in EMDAT may reflect data availability and our restriction to studies in English.

Most studies use data at the micro level— household (35 percent) or individual (21 percent)— while 38 percent use data at the country level and 27 percent at the subnational level (Table 1). These shares are not mutually exclusive since some studies provide estimates using data at different levels. At the estimate level, 54 percent use data at the country level to estimate the poor's exposure to climate shocks and almost 40 percent use country-level data to estimate the adverse impact of climate shocks on the poor (Table 2). The channels through which the poor are more adversely affected by climate shocks than the non-poor include income reduction (almost a third of estimates), aggregate human capital losses (17 percent of estimates), mortality, poor health, and food insecurity (about 6 percent of estimates each).

*3.2 Climate shock exposure*

More than two-thirds (68 percent) of estimates found that the poor are statistically significantly more exposed to climate shocks (Table 2). Of the estimates that are not from the World Bank's CCDRs, 59 percent documented greater exposure of the poor, especially to droughts, extreme heat, and floods (together about three-quarters of estimates). Compared with studies of other natural disasters, studies of heat were 22 percentage points more likely to find that the poor were more exposed than the average household or country. Studies on droughts were 19 percentage points more likely to find that the poor were more exposed and studies on floods were 29 percentage points more likely to find that the poor were more exposed (Table 4, columns 1-2). When the CCDRs are excluded, the results on exposure are qualitatively similar.

The prevalence of studies finding that the poor are more exposed to shocks may reflect the data used in these studies. For example, there is some evidence that the poor are more exposed to floods than other households—but only in urban areas, not in rural areas where the very poorest tend to live (Hallegatte et al. 2020). There is also evidence that the increase in the poor's exposure to climate shocks since the 1970s predominantly stems from an increase in their concentration in high-risk zones (Kim 2012). Consequently, individuals living in poverty are nearly twice as

susceptible to the impacts of such disasters than those with higher income, emphasizing the intricate link between poverty and vulnerability to natural disasters.

### *3.3 Climate shock impacts*

Some evidence suggests that exposure is similar across poor and non-poor households or regions, and the differences in impacts are driven by resources available for recovery (Anttila-Hughes and Hsiang 2013; Hallegatte, Fay, and Barbier 2018). For example, in Honduras, the poor and non-poor are equally exposed to hurricanes, but the effect on the poor is more severe ( Hallegatte et al. 2016). Similarly, there is no differential exposure to floods in Moldova, Rwanda, Slovak Republic, and Sudan, but the ability to recover and cope with flooding depends on relative socio-economic status and resources available (Hallegatte et al. 2016).

Consistent with earlier reviews, 80 percent of the studies in our sample find that the poor are more adversely affected by climate shocks than are other households—a finding that emerges from both CCDR and non-CCDR studies (Table 2). Greater impacts on the poor were identified in studies of droughts (92 percent), extreme heat (100 percent), and floods (88 percent; Table 5). Compared with studies of other shocks, studies of droughts were 19 percentage points more likely to show a greater impact on the poor than on other households. Studies of floods found a 28 percentage-point higher impact on the poor (Table 4, columns 3-4).

### *3.4 Potential channels*

The socio-economic effects of climate shocks can affect many domains (Carleton and Hsiang 2016). At the individual level, the impacts vary widely throughout the life cycle—and include mortality as well as temporal and persistent effects in education, health, and the labor market. The persistence of the effects is especially concerning in settings in which the duration of post-disaster assistance may be limited, and income losses push households further into poverty or extend the duration of poverty. For example, Hallegatte et al. (2016) show that the poor and non-poor are equally exposed to droughts in Niger, Peru, and Bolivia, but the poor are more adversely affected because they work predominantly in agriculture, where droughts reduce agricultural productivity. In the aggregate, these effects may reduce economic growth due to lower productivity and costly

post-disaster recovery. The studies in our sample examine a number of effects, including income and asset losses, human capital losses, and mortality. Some studies also examine the long-term effects of climate shocks.

Relative to all other channels, studies that focuses on poverty, income and human capital were more likely to show more persistent and worse impacts on the poor (Table 4, columns 5-6). Studies show that, after climate shocks, poor households can persist in poverty for prolonged periods (Carter et al. 2007) and that poor countries struggle with more persistent poverty (Dang, Hallegatte, and Trinh 2023).

### *3.4.1 Income and livelihood loss*

Among estimates that focus on income, 80 percent show worse outcomes for the poor (Table 5). The majority of the poor live in rural areas where agriculture is their main source of livelihood and income. A number of studies have documented the importance of income and livelihood losses in agriculture, which is very vulnerable to climate shocks. Barbier (2015) examines the effect of climate change on the rural poor who live in low-elevation coastal zones and finds that their economic livelihoods are directly affected by coastal hazards because of their high dependence on agriculture and fishing—sectors that are especially susceptible to disruptions caused by rising sea-levels, storm surges, and coastal erosion. Aalst, Koomen, and Groot (2023) analyze the vulnerability and resilience to drought and salt intrusion among rice farmers in Vietnam's rural Mekong Delta. They find that poorer communes are more vulnerable to direct environmental impacts because of declines in rice yield. Yuan et al. (2022) find that rising temperatures in China disproportionately affect the agricultural sector, particularly in lower income regions. Reardon and Taylor (1996) examine the impacts of agroclimatic shocks on income inequality and poverty in Burkina Faso and find that the lack of access to off-farm income among the poor is an important channel.

Beyond the initial impact, natural disasters may affect poor households for a number of periods because of the limited resources available to them for recovery. For example, in Sri Lanka, households in the bottom two quintiles experienced a higher-than-average share of income losses, which persisted for two years after the shocks (Keerthiratne and Tol 2018). In the United States,

using 22 years of data, the income and the assets of the poor who were affected by natural disasters were significantly lower over the longer term than those of the poor who were not affected by them (Pleninger 2022). In Ethiopia and Honduras, natural disasters pushed poor households into poverty traps in which recovery from natural disasters took longer than it did among other households (Carter et al. 2007).

At the aggregate, Dell, Jones, and Olken (2012) find that higher temperatures reduce economic growth in poor countries. The channels include lower agricultural and industrial output, and more political instability. Additionally, they find that the adverse effects of temperature are concentrated in poor countries. These results raise the concern of a reduced ability to grow among poor countries, which can have medium- and long-term consequences. Indeed, evidence from typhoons suggests that climate shocks reduce per-capita income, and this effect persists up to 20 years (Hsiang and Jina 2014). These persistent income losses following climate shocks pose the risk of poverty traps.

### *3.4.2 Mortality and human capital losses*

Climate shocks generally increase mortality and reduce the human capital of survivors (Carleton and Hsiang 2016; Baez 2010). Indeed, about 80 percent of studies that focus on human capital find that the poor are more adversely affected than the non-poor (Table 5). Deschenes (2009) estimates an immediate increase in mortality rates in the United States following extreme weather events. Poorer countries suffer more deaths from climate shocks, while higher economic development and countries with higher quality institutions suffer less death (Kahn 2005). Among those who survive, climate shocks can still negatively affect education and health. Abiona (2022) analyzes the impact of droughts on birth outcomes in rural Sierra Leone, and finds the adverse effects concentrated among poorer households, with some evidence for maternal nutrition and gestation as pathways. Hoddinott (2001) examines the impact of a drought in Zimbabwe and finds that exposed children are on average shorter than peers who were unexposed to the drought.

There is a large and growing literature on the effects of climate shocks on human capital outcomes, including studies on the persistence of early-life shocks (Currie 2016; Hanna and Oliva 2016). While most of these studies are beyond the scope of our analysis, the interaction between mortality

selection, post-disaster aid, and later life human capital investments provides some insight into the need for targeted policies. The selection of survivors creates the paradox of mortality selection in many lower income settings.[6] In the Philippines, child mortality for families in the poorest decile increases after typhoons and this increase persists (Anttila-Hughes and Hsiang 2013). Children who survived typhoons in early life experienced negative short- and long-term effects in education, but not in health (Deuchert and Felfe 2015). With the introduction of short-term disaster relief, the probability of survival increased for children exposed to typhoons, but that resulted in a greater chance of poor human capital outcomes for survivors (Triyana and Xia 2023). These findings highlight the need for targeted, and potentially longer-term social assistance for affected poor households.

Human capital has been shown to be protective during shocks, therefore investing in health, education, and skills can build climate resilience (Hoffmann and Muttarak 2017; Frankenberg et al. 2013). The role of adaptive social protection is increasingly important (Bowen et al. 2020). Recent evidence shows the protective effect of social protection programs when climate shocks occur (Duque, Rosales-Rueda, and Sanchez 2018). Well-targeted social assistance programs can lead to sustained increases in human capital (Millán et al. 2020), which in the aggregate can contribute to the economic development that is critical to minimizing the negative effects of climate shocks.

## 4. Policy Implications and Conclusion

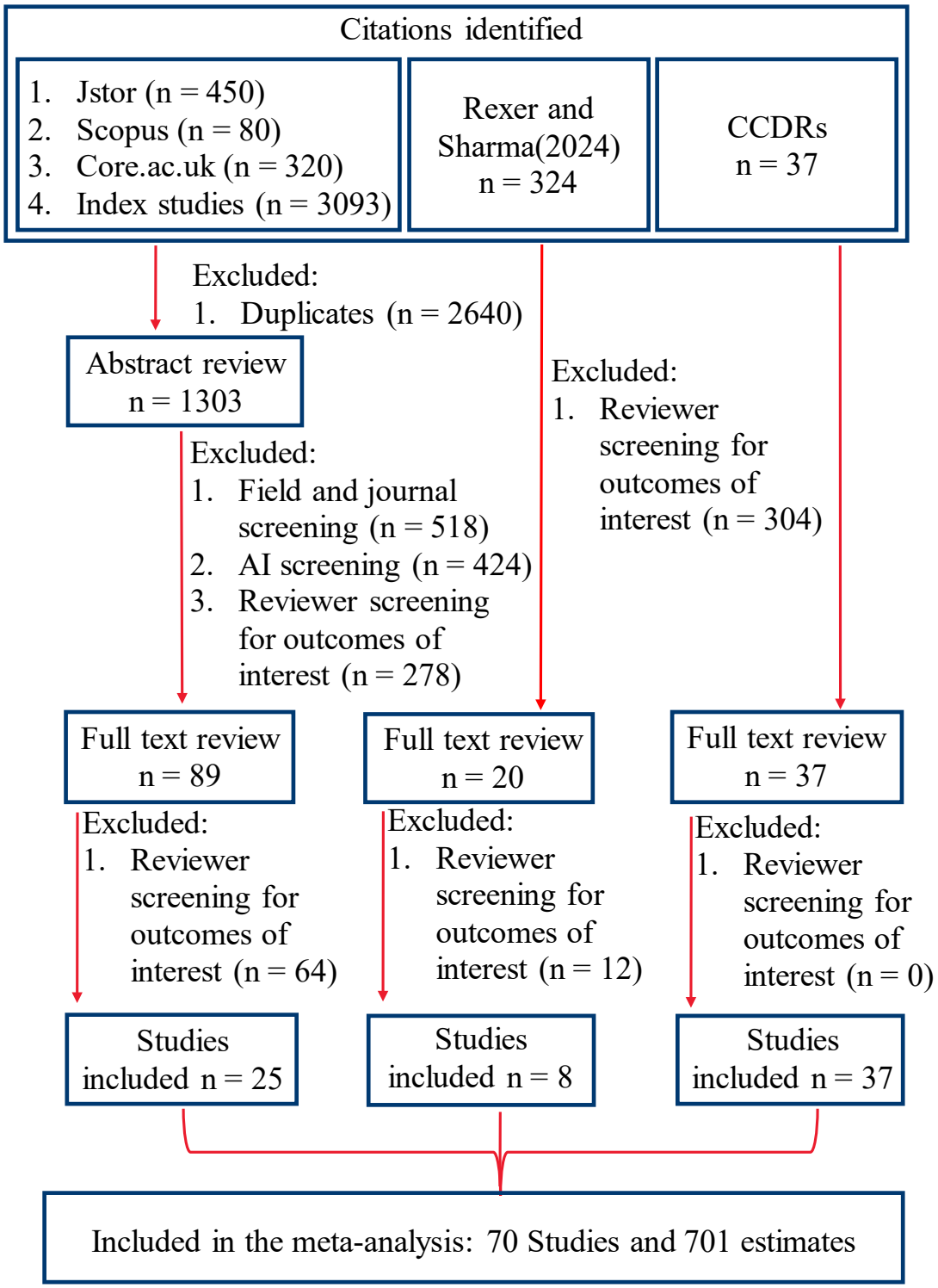
We review the literature to examine whether the poor are more exposed to climate shocks and whether they are more adversely affected by climate shocks. In our analyzed sample, the poor are more exposed to climate shocks and are more adversely affected by climate shocks than are the non-poor, which suggests that support for poor households should be prioritized. In the aggregate, to protect poor countries from the impacts of climate shocks, institutional preparedness through policies such as disaster risk financing and market insurance can help countries minimize damages

[6] If the strongest are more likely to survive, high mortality rates could correspond to better outcomes in the recovery period due to the positive selection of survivors. In other words, when mortality rates decline, the outcomes of survivors may be worse.

from climate shocks (Hallegatte et al. 2016). Policies that promote general economic development and human capital accumulation will also build climate resilience.

**Tables and Figures**

**Figure 1. Sample selection**




*Note*: CCDR = *Country Climate and Development Report*. Rexer and Sharma (2024) document 324 relevant climate change adaptation studies. Among 324 relevant climate change adaptation studies, eight document either the poor's exposure to climate shocks or impact of climate shocks on the poor.

**Table 1. Study characteristics**

| | | All | | Excl. CCDRs | |
|---|---|---|---|---|---|
| | | Share | SD | Share | SD |
| Country or region | Sub-Saharan Africa | 0.243 | 0.432 | 0.121 | 0.331 |
| | Global | 0.171 | 0.380 | 0.364 | 0.489 |
| | East Asia and Pacific | 0.157 | 0.367 | 0.182 | 0.392 |
| | South Asia | 0.129 | 0.337 | 0.182 | 0.392 |
| | East Asia and Pacific | 0.100 | 0.302 | 0.030 | 0.174 |
| | Europe and Central Asia | 0.071 | 0.259 | 0 | 0 |
| | Middle East and North Africa | 0.071 | 0.259 | 0 | 0 |
| | United States | 0.057 | 0.234 | 0.121 | 0.331 |
| Type of shock | Climate change | 0.571 | 0.498 | 0.212 | 0.415 |
| | Natural disaster | 0.214 | 0.413 | 0.242 | 0.435 |
| | Temperature | 0.329 | 0.473 | 0.303 | 0.467 |
| | Heat | 0.200 | 0.403 | 0.061 | 0.242 |
| | Typhoon/cyclone/hurricane | 0.086 | 0.282 | 0.121 | 0.331 |
| | Rainfall | 0.086 | 0.282 | 0.061 | 0.242 |
| | Flood | 0.229 | 0.423 | 0.182 | 0.392 |
| | Drought | 0.200 | 0.403 | 0.152 | 0.364 |
| | Earthquake | 0.057 | 0.234 | 0.061 | 0.242 |
| | Landslide | 0.057 | 0.234 | 0.030 | 0.174 |
| Level of analysis | Country | 0.377 | 0.488 | 0.313 | 0.471 |
| | Subnational | 0.269 | 0.448 | 0.226 | 0.425 |
| | Household | 0.346 | 0.480 | 0.355 | 0.486 |
| | Individual | 0.212 | 0.412 | 0.129 | 0.341 |

*Note*: CCDR = *Country Climate and Development Report*. Sample has 70 studies. When the CCDRs are excluded, the sample has 33 studies. Each row represents the share of studies in our sample with the specific characteristic. Country or region indicators, type of shock indicators, and level of analysis indicators are not mutually exclusive.

**Table 2. Characteristics of estimates in the analyzed sample**

| | | All estimates | | | | Excl. CCDRs | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | The poor are more exposed | | The poor are more adversely affected | | The poor are more exposed | | The poor are more adversely affected | |
| | | Share | SD | Share | SD | Share | SD | Share | SD |
| Outcome | | 0.679 | 0.468 | 0.805 | 0.397 | 0.585 | 0.495 | 0.762 | 0.426 |
| Type of shock | Climate change | 0.103 | 0.305 | 0.177 | 0.382 | 0.035 | 0.185 | 0.097 | 0.296 |
| | Natural disaster | 0.245 | 0.431 | 0.182 | 0.386 | 0.303 | 0.461 | 0.210 | 0.408 |
| | Temperature | 0.152 | 0.360 | 0.312 | 0.464 | 0.148 | 0.356 | 0.376 | 0.485 |
| | Heat | 0.071 | 0.257 | 0.007 | 0.082 | 0.056 | 0.231 | 0.000 | 0.000 |
| | Typhoon/cyclone/hurricane | 0.016 | 0.127 | 0.018 | 0.133 | 0.014 | 0.118 | 0.019 | 0.138 |
| | Rainfall | 0.016 | 0.127 | 0.004 | 0.067 | 0.007 | 0.084 | 0.003 | 0.053 |
| | Flood | 0.234 | 0.424 | 0.083 | 0.276 | 0.246 | 0.432 | 0.075 | 0.263 |
| | Drought | 0.152 | 0.360 | 0.056 | 0.230 | 0.169 | 0.376 | 0.033 | 0.179 |
| | Earthquake | 0.000 | 0.000 | 0.002 | 0.047 | 0.000 | 0.000 | 0.003 | 0.053 |
| | Landslide | 0.022 | 0.146 | 0.011 | 0.105 | 0.014 | 0.118 | 0.008 | 0.091 |
| Country or region | Global | 0.207 | 0.406 | 0.296 | 0.457 | 0.268 | 0.444 | 0.365 | 0.482 |
| | United States | 0.087 | 0.283 | 0.063 | 0.243 | 0.113 | 0.317 | 0.077 | 0.268 |
| | Sub-Saharan Africa | 0.228 | 0.421 | 0.173 | 0.378 | 0.183 | 0.388 | 0.110 | 0.314 |
| | South Asia | 0.103 | 0.305 | 0.224 | 0.418 | 0.070 | 0.257 | 0.246 | 0.431 |
| | East Asia and Pacific | 0.130 | 0.338 | 0.135 | 0.342 | 0.099 | 0.299 | 0.141 | 0.348 |
| | Latin America and Caribbean | 0.168 | 0.375 | 0.065 | 0.247 | 0.190 | 0.394 | 0.047 | 0.212 |
| | Europe and Central Asia | 0.022 | 0.146 | 0.016 | 0.124 | 0.014 | 0.118 | 0.006 | 0.074 |
| | Middle East and North Africa | 0.027 | 0.163 | 0.027 | 0.162 | 0.028 | 0.166 | 0.006 | 0.074 |
| Level of analysis | Country | 0.538 | 0.500 | 0.386 | 0.487 | 0.451 | 0.499 | 0.337 | 0.473 |
| | Subnational | 0.179 | 0.385 | 0.265 | 0.442 | 0.211 | 0.410 | 0.282 | 0.450 |
| | Household | 0.185 | 0.389 | 0.265 | 0.442 | 0.211 | 0.410 | 0.298 | 0.458 |
| | Individual | 0.103 | 0.305 | 0.085 | 0.279 | 0.134 | 0.342 | 0.083 | 0.276 |
| Channels | Income reduction | - | | 0.276 | 0.447 | - | | 0.326 | 0.469 |
| | Expenditure reduction | | | 0.038 | 0.192 | | | 0.036 | 0.186 |
| | Welfare loss | - | | 0.009 | 0.094 | - | | 0.000 | 0.000 |
| | Asset loss | - | | 0.027 | 0.162 | - | | 0.022 | 0.147 |
| | Human capital loss | - | | 0.166 | 0.372 | - | | 0.166 | 0.372 |
| | Food insecurity | - | | 0.058 | 0.235 | - | | 0.055 | 0.229 |
| | Poor health | - | | 0.056 | 0.230 | - | | 0.061 | 0.239 |
| | Education loss | - | | 0.016 | 0.124 | - | | 0.017 | 0.128 |
| | Mortality | - | | 0.063 | 0.243 | - | | 0.077 | 0.268 |
| Number of observations | | 184 | | 446 | | 142 | | 362 | |

*Note:* CCDR = *Country Climate and Development Report.* Estimates are from 70 studies. When CCDRs are excluded, the sample on which estimates are based shrinks to 33 studies. Each row represents the share of estimates in our sample with the specific characteristic. Country or region indicators, type of shock indicators, level of analysis indicators, and channel indicators are not mutually exclusive.

**Table 3. Comparison between the analyzed sample and the Emergency Events database**

| | | Proportion in the sample | EMDAT proportion | Difference | P value |
|---|---|---|---|---|---|
| Type of shock | Drought | 0.0637 | 0.0405 | 0.023*** | <0.01 |
| | Flood | 0.0306 | 0.4060 | -0.375*** | <0.01 |
| | Heat | 0.1201 | 0.0194 | 0.101 | 0.040 |
| Country or region | South Asia | 0.1765 | 0.1055 | 0.071*** | <0.01 |
| | Sub-Saharan Africa | 0.1826 | 0.1942 | -0.012 | 0.447 |
| | East Asia and Pacific | 0.1409 | 0.2294 | -0.088*** | <0.01 |
| | Europe and Central Asia | 0.0380 | 0.0807 | -0.043*** | <0.01 |
| | Latin America and the Caribbean | 0.0980 | 0.1621 | -0.064*** | <0.01 |
| | Middle East and North Africa | 0.0331 | 0.0475 | -0.014 | 0.072 |

*Note:* CCDR = *Country Climate and Development Report.* EMDAT = Emergency Events database. It was last accessed on November 28, 2023. Proportion in the sample refers to the share of 70 studies in the sample that analyzed the specific shock or region.

**Table 4. Marginal probability of study documenting above-average exposure and adverse impact for the poor**

| | | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|---|
| | | Poor more exposed | | Poor more adversely affected | | | |
| | | All | Excl. CCDRs | All | Excl. CCDRs | All | Excl. CCDRs |
| Type of shock | Climate change | | | 0.216*** | 0.181*** | 1.127*** | 0.976*** |
| | | | | (0.030) | (0.029) | (0.199) | (0.057) |
| | Heat | 0.224*** | 0.156*** | | | | |
| | | (0.055) | (0.041) | | | | |
| | Flood | 0.190*** | 0.367*** | 0.280*** | 0.290*** | 1.224*** | 1.345*** |
| | | (0.067) | (0.003) | (0.058) | (0.050) | (0.111) | (0.114) |
| | Drought | 0.289*** | 0.536*** | 0.189*** | 0.179*** | 0.896*** | 0.774*** |
| | | (0.040) | (0.001) | (0.044) | (0.038) | (0.064) | (0.210) |
| Country or region | United States | -0.265** | -0.339*** | -0.240*** | -0.410*** | -1.558*** | -2.005*** |
| | | (0.134) | (0.065) | (0.049) | (0.072) | (0.273) | (0.240) |
| | Sub-Saharan Africa | 0.068*** | -0.079*** | -0.143*** | -0.344*** | -0.871*** | -1.519*** |
| | | (0.009) | (0.026) | (0.017) | (0.067) | (0.124) | (0.273) |
| | South Asia | | | 0.079*** | -0.012** | 0.154 | -0.250* |
| | | | | (0.009) | (0.005) | (0.107) | (0.105) |
| | East Asia and Pacific | -0.235*** | -1.042*** | 0.077*** | 0.004*** | 0.280*** | -0.0969 |
| | | (0.017) | (0.097) | (0.007) | (0.001) | (0.002) | (0.069) |
| | Latin America and Caribbean | -0.423*** | -0.762*** | 0.309*** | 0.246*** | 1.187*** | 0.964*** |
| | | (0.014) | (0.056) | (0.039) | (0.032) | (0.258) | (0.135) |
| | Europe and Central Asia | -0.239*** | | | | | |
| | | (0.049) | | | | | |
| | Middle East and North Africa | 0.107*** | -0.365*** | | | | |
| | | (0.041) | (0.049) | | | | |
| Outcome Channels | Income reduction | | | | | 0.570*** | 0.632*** |
| | | | | | | (0.068) | (0.028) |
| | Increased poverty | | | | | 0.849*** | 0.657*** |
| | | | | | | (0 .062) | (0.113) |
| | Asset losses | | | | | -0.100 | -0.599*** |
| | | | | | | (0.184) | (0.084) |
| | Human capital losses | | | | | 0.177*** | 0.264*** |
| | | | | | | (0.001) | (0.025) |
| Number of observations | | 148 | 125 | 424 | 358 | 424 | 358 |
| Mean of the dependent variable | | 0.68 | 0.58 | 0.80 | 0.76 | 0.80 | 0.76 |

*Note*: *CCDR = Country Climate and Development Report.* Marginal probabilities from a probit regression of the probability that a study finds a greater exposure of the poor to climate shocks (columns 1–2) or a greater impact of climate shocks on the poor (columns 3–6) than for other households. Columns 5–6 include the outcomes of studies that analyze the impact of climate shocks on the poor. Sample has 70 studies, of which 37 are CCDRs. Even columns exclude the CCDRs. The unit of observation in the regression is the study estimate. Excluded shock category is any natural disaster, excluded region or country is global. Level of analysis dummies: subnational, household, individual, and country is the excluded category. Standard errors clustered at the study level. Significance: * p<0.10, ** p<0.05, *** p<0.01.

**Table 5. Share of estimates documenting exposure and impact by climate shock and channels**

A. Share of estimates that report the poor are more exposed by specific climate shocks

| | All Studies | | Excluding CCDR | |
|---|---|---|---|---|
| | Number of estimates | Share that finds the poor are more exposed (%) | Number of estimates | Share that finds the poor are more exposed (%) |
| Heat | 13 | 84.62 | 8 | 75 |
| Flood | 43 | 76.74 | 35 | 71.43 |
| Drought | 28 | 78.57 | 24 | 75 |

B. Share of estimates that report the poor are more affected by specific climate shocks

| | All Studies | | Excluding CCDR | |
|---|---|---|---|---|
| | Number of estimates | Share that finds worse impact on the poor (%) | Number of estimates | Share that finds worse impact on the poor (%) |
| Heat | 3 | 100 | 0 | . |
| Flood | 37 | 91.89 | 27 | 88.89 |
| Drought | 25 | 88 | 12 | 75 |

C. Share of estimates that find worse outcome for the poor through specific channels

| | Number of estimates | Share that reports the poor are more adversely affected (%) |
|---|---|---|
| Income loss | 123 | 80.48 |
| Human capital loss | 74 | 81.08 |
| Expenditure reduction | 17 | 52.94 |
| Lower education | 7 | 100 |
| Poor health | 25 | 68 |
| Food security | 26 | 100 |
| Asset loss | 12 | 83.33 |
| Growth reduction | 61 | 65.57 |
| Poverty | 66 | 89.39 |

*Note*: CCDR = *Country Climate and Development Reports*. A. Sample covers 33 studies, of which 22 are CCDRs. B. Only CCDRs estimate the impact of extreme heat. Sample covers 61 studies, of which 34 are CCDRs. C. Sample covers 61 studies, of which 34 are CCDRs. Income includes earnings. Human capital includes education, health, crime, and food security. Sample includes 123 estimates on income from 11 studies, 74 estimates on human capital from 16 studies, 17 estimates on household expenditure cuts from 5 studies, 12 estimates on asset losses from eight studies, and 28 estimates on mortality from five studies.

**Appendix. Analyzed Studies**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