

Climate change and multidimensional poverty: global, subnational and household-level evidence

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15/02/2026

Long abstract:

Climate change is one of the most pressing challenges of this century. This is more so for developing and least developed countries, which have limited means of adaptation and a high proportion of vulnerable populations (Carleton 2016, Castells-Quintana 2018). The South Asian region, home to one-quarter of the world's population, is particularly susceptible to the adverse effects of climate change (Sivakumar 2011). Studies show a consistent increase in average temperature levels in the region (Saeed 2021), which is likely to have important impacts in terms of poverty and inequality in the region. Understanding these interconnections between climate, poverty, and inequality is fundamental in the design of effective policies aimed at adapting to climate change (SDG 13), as well as reducing poverty and inequality (SDG 1 and 10).

This paper focuses on the interconnection between climate and multidimensional poverty. We first provide evidence at the cross-country level (for over 70 countries worldwide) as well as the subnational level (for 343 subnational regions in Asia). We then focus on India, where we provide evidence of the linkages at sub-national, district, and household levels. India is currently the most populous country in the world. Furthermore, India has extensive data on several socioeconomic outcomes at several levels, which is particularly beneficial for our analysis. India also remains highly vulnerable to climate change as a significant proportion of the population in the country relies on the agricultural sector (Gulati 2022, Taraz 2018). Furthermore, the majority of the farmers are small to marginal landholders with limited financial and physical resources to adapt (Asher 2022, Deressa 2009, Sivakumar 2011). Likewise, a large segment of India's urban

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population engaged in informal sectors, such as construction and manufacturing sectors, is particularly vulnerable to temperature rises and weather-related shocks, such as heatwaves and floods (Dodman 2023, Odonkor 2022). India is also expected to experience indirect effects of climate change, such as decreasing water availability and increased burden of disease (Zaveri 2016, Moors 2013). Our aim is to examine the long-run impacts of climate change, including temperature rises, precipitation changes, climatic anomalies and droughts, on multidimensional poverty in India. In doing so, we also explore the potential underlying mechanisms driving these effects.

In our study, we adopt the global multidimensional poverty index (MPI) as our primary outcome variable. The global MPI is an internationally comparable measure of acute poverty and builds on ten non-monetary deprivation indicators, which capture critical shortfalls in the dimensions of health, education and living standard (Alkire & Santos 2014). At the sub-national level, we use global MPI data, which is based on deprivation indicators harmonized over time and published by the Oxford Poverty and Development Initiative (OPHI). We also offer analyses at the district-level for India. As global MPI estimates for India are currently only published for subnational regions, we estimate all MPI-related outcome variables at the district-level using the underlying survey datasets. Finally, we also offer a micro-level analysis of multidimensional poverty at household level.

We then match our poverty data with climate measures created using gridded data on temperature, precipitation, and moisture levels captured by the Standardized Precipitation Evapotranspiration Index (SPEI). Using this rich dataset, we implement several panel data econometric techniques, including alternative fixed-effects specifications, as well as long-differences and difference-in-difference specifications (and a battery of robustness checks), to estimate the causal impact of changes in climatic conditions on multidimensional poverty.

Using household-level data, we examine the effects both in rural and urban areas of India. Thus, we explore the general equilibrium effects of climate change on poverty using a reduced-form econometric specification. In this regard, our study aligns closely with the work of (Azzarri 2020), which investigates similar effects in Sub-Saharan Africa.

Our findings indicate a strong association between rising temperatures, more temperature anomalies and droughts, and increases in multidimensional poverty. For India, benefiting from our rich micro data, we analyze the different components of MPI. We find that the impacts of rising temperatures are particularly pronounced on deprivation related living conditions (i.e., housing and access to electricity) and nutrition. Finally, we provide supporting evidence, exploiting detailed remote-sensing data, suggesting that the detrimental impacts of rising

temperatures may be (partly) driven by decreases in vegetation (i.e., reduced greenness) and lower economic activity (as proxied by nightlight intensity).

Furthermore, to assess external validity, we provide additional evidence on the increase in temperature and its relationship with rising multidimensional poverty at the sub-national level across seven Southeast Asian countries geographically close to India. Our findings consistently show that rising temperatures have harmful effects on poverty across the entire region. This highlights the urgent need for further research on this critical issue to support effective policymaking related to climate change adaptation.

Our paper relates to several strands in the literature. First, based on the works of Castells-Quintana and McDermott (2024) globally, and Azzarri (2020) for Sub-Saharan Africa, we offer empirical evidence on the long-term effects of climate change on poverty at sub-national, district, and household level in India. Through this evidence, we contribute to previous influential research examining the adverse impacts of rising temperatures and low precipitation on economic growth in poor countries, such as by Dell et al. (2012). Besides, we also contribute to the growing body of literature focusing on assessing the direct effects of climate change on poverty in developing countries (Aggarwal 2020, Sedova 2020, Dang 2024, Hallegatte 2017). Furthermore, our study makes a crucial contribution to the literature on climate change and poverty by highlighting how climate change can have a compounded impact on poverty across multiple dimensions. Previous research has examined multidimensional poverty in India in-depth at the national and the state-level, paying particular attention to how poverty is evolving over time. By exploring the link between climate and MPI in India at different geographical levels, we complement this research with evidence on climate changes being one important driver of the observed trends. Finally, we supplement the literature examining the economic effects of climate change specific to the Indian context. Existing studies have only concentrated on consumption-based inequality (Aggarwal 2020, Sedova 2020).

Keywords: Climate change, multidimensional poverty, inequality, India

JEL classification: I32, Q54