



Human capital, mobility, and climate change adaptation

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- Climate change is already reducing agricultural yields and incomes.
- The least developed regions and households suffer the most from climate shocks.
- Human capital helps people adapt by moving to better opportunities.
- A large-scale education expansion programme in India in the 1990s increased schooling, migration, and non-farm work.
- Greater human capital due to the programme offset climate damages and boosted resilience.

Climate change seriously threatens communities that rely on agriculture in low- and middle-income countries. The majority of those in poverty earn their living directly or indirectly from farming; rising temperatures and shifting rainfall are eroding the productivity of their main source of livelihood. Smallholder farmers often lack the resources or scale to invest in irrigation, new seeds, or other technologies to buffer their crops against climate shocks. As a result, climate change hits vulnerable rural populations hardest, undermining their income and food security.

One strategy for adaptation is for people to shift into new types of jobs or relocate to less climate-affected areas. However, the barriers that trap people in low-wage farming (such as lack of skills, credit constraints, or social ties) also prevent them from escaping climate risks. As climate pressures worsen, a key question emerges: how can those in poverty adapt in time to protect their livelihoods?

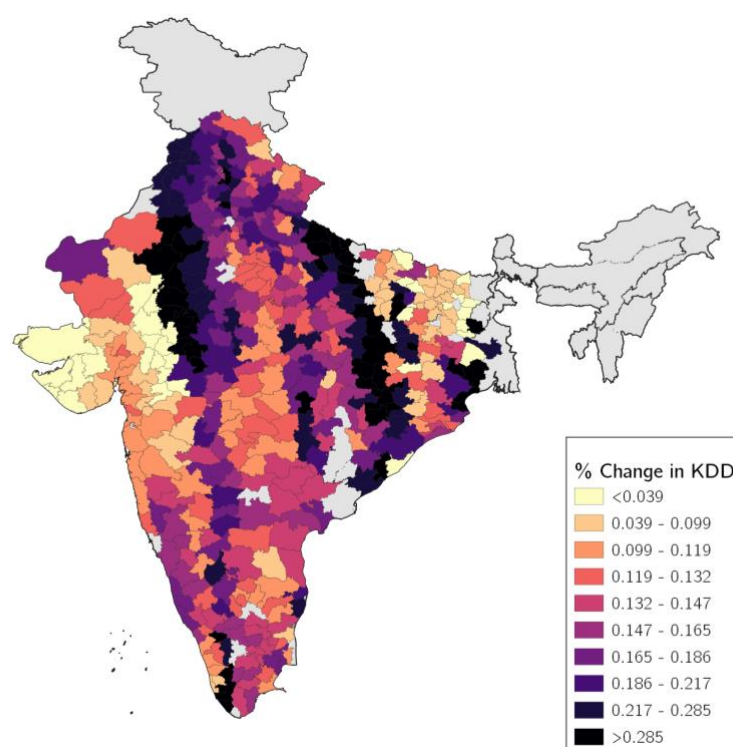
This brief suggests that investing in human capital – education and skills – is crucial to supporting adaptation for vulnerable populations. Human capital allows people to take up better-paying, less climate-sensitive occupations or move to places with more opportunities. Knowledge and skills provide a form of resilience that weather cannot take away.

This policy brief highlights key findings from recent research on the role of human capital in climate change adaptation. Drawing on evidence from India, it shows how education facilitates labour mobility and economic transformation in response to climate stress. It concludes with policy recommendations for governments and international organisations to help low- and middle-income countries build adaptive capacity through human capital development.

Climate change and human capital in India

Climate change is already reducing agricultural yields and incomes

FIGURE 1: Increase in crop-destroying "killing degree days" between 1991 and 2011



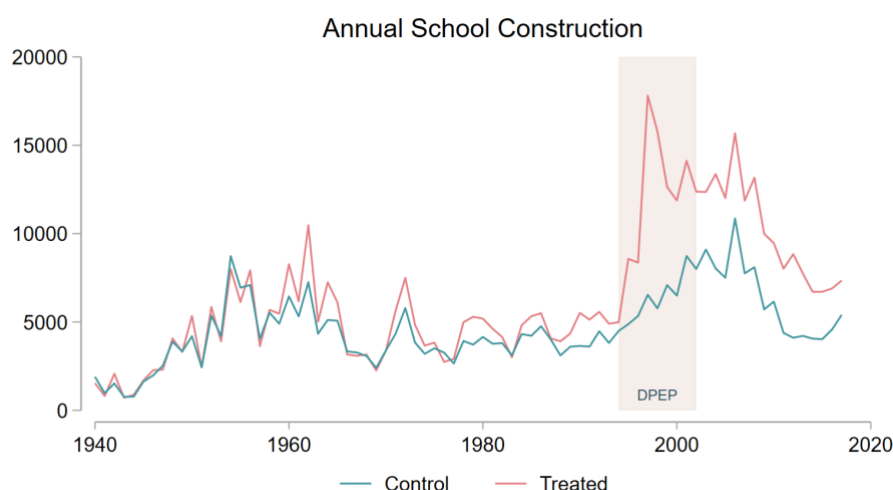
Note: The most affected areas, in black, saw more than a 28.5% increase.

Climate change has measurably harmed agriculture in recent decades, especially in tropical countries. In India, for example, over 90% of regions have experienced an increase in extremely hot days that damage crops since 1980. These high-temperature extremes – known as "killing degree days" (KDD) –

have risen by about 14% during the growing season. Such heat stress directly lowers crop yields. If these damaging hot days could be completely avoided, Indian crop yields would be about 17% higher. Even returning KDD levels to 1980s values would increase average yields by around 4%. Lower yields translate into lost income for farm households, pushing vulnerable communities further into poverty. Without adaptation, climate change will continue to erode livelihoods in agriculture, threatening food security and rural welfare. Future warming is expected to exacerbate these impacts, underscoring the urgent need for strategies to protect farmers and stabilise yields.

A large-scale schooling expansion programme in India increased schooling, migration, and non-farm work

FIGURE 2: Annual school construction throughout India as part of the District Primary Education Programme



Human capital facilitates adaptation through mobility and economic transformation. In the 1990s, India launched a large-scale schooling initiative called the District Primary Education Programme (DPEP) to improve access to education in underserved areas. This programme led to a 19% increase in the number of primary schools in targeted districts, raising the average years of schooling in those areas by about 0.6 years. Over time, districts that benefited from the schooling boom had significantly more people leave agriculture than districts that did not receive additional primary schools. In treated areas, the share of adults working in agriculture dropped about 7.9 percentage points more than in comparison areas over two decades. Many of these new jobs were likely obtained in nearby towns and cities. Consistent with this, higher levels of education led to more migration from rural villages to urban centres in India. This evidence shows that boosting education can trigger structural change: labour shifted from low-productivity farm work to better-paying jobs in services or industry as schooling levels rose. Crucially, this migration and reallocation was not observed in areas without education investment, indicating

that human capital was the key differentiating factor enabling adaptation. This case illustrates how an education policy can equip rural workers to transform their livelihoods.

Why human capital matters for climate adaptation

Human capital helps people adapt by moving to better opportunities

Investing in education and skills dramatically improves a population's capacity to adapt to climate change. Education opens alternatives to climate-vulnerable farming by enabling people to work in sectors and locations less affected by weather. Those with more years of schooling have better opportunities to reallocate out of agriculture sooner, entering jobs in manufacturing or services that are not as dependent on climate conditions. In economic terms, jobs less exposed to climate shocks are typically found in "markets for human capital" – occupations requiring skills and training. Human capital also makes it easier for individuals to migrate for work. People with higher education are more likely to move to urban areas for employment. Globally, rising education levels across generations have been a major driver of workers shifting from agriculture to other sectors. By building human capital, societies give citizens the tools to pursue safer and more productive livelihoods, reducing their vulnerability to climate variability.

Human capital investments have offset climate damage and boosted resilience

Did this story play out in India? The expansion of education in India helped counteract climate-related losses. Those with greater human capital are more likely to leave agriculture and migrate in response to a worsening climate. Whereas climate change tends to pull those with less human capital back into agriculture as incomes fall, areas with greater human capital investments saw the opposite effect. Labour left the fields and worked in other sectors or locations less exposed to the whims of the weather. Overall, areas that benefited more from the school expansion saw greater levels of welfare, even after accounting for the negative impacts of climate change.

The impacts of climate change remain unequal

Climate change impacts are unequally distributed, with the poorest and most agriculture-dependent populations bearing the heaviest burden. In India, climate change has cut welfare by over 6% in the lowest-income quintile of districts, while the richest areas have been almost unaffected. In remote rural regions, crop failures or lower yields directly hit household consumption and income, whereas urban economies are more diversified and insulated. Nationwide,

climate change has reduced India's aggregate economic welfare by an estimated 3% since the 1980s, masking the severe losses concentrated in rural and low-income areas. Low-income farmers lose harvests and have fewer resources to fall back on when shocks occur. Many cannot find alternative work without skills or connections, trapping them in place as conditions worsen. This creates a cycle wherein climate stress aggravates existing inequalities – precisely, those with the least capacity to adapt are hit hardest. Ensuring that adaptation strategies reach and benefit the poorest regions is therefore critical. Otherwise, climate change threatens to widen welfare gaps between wealthy urban centres and vulnerable rural communities.

Recommendations for policy

Policymakers should leverage human capital for climate resilience in low- and middle-income countries:

- **Invest in education and skills development for climate adaptation:** Expanding access to quality education (especially in rural and climate-vulnerable regions) will enhance people's ability to cope with climate change. Better-educated individuals can shift to less climate-sensitive livelihoods and adopt new technologies more easily. These human capital investments build a long-term foundation for adaptation.
- **Improve access to labour markets for rural populations:** Breaking the isolation of rural communities is key to helping people use their skills. Currently, many of those in poverty live far from cities or job opportunities and face high costs to migrate or commute. Policies can reduce these frictions by improving rural infrastructure (roads, transport, internet connectivity) and providing information about job opportunities in towns and cities. Rural employment services or safe migration schemes can connect villagers to urban labour markets. By lowering the barriers to mobility, rural workers with education can more readily find better-paying, climate-resilient jobs.
- **Strengthen social protection for vulnerable households affected by climate change:** Even with more education and mobility, many rural families will still face climate shocks (droughts, floods, crop failures) that threaten their livelihoods. Robust safety nets are needed to prevent these shocks from pushing people into destitution or forcing negative coping strategies. Governments should expand social protection programs – such as cash transfer schemes, crop insurance, public works, or food assistance – targeted at farmers and low-income households in climate-stressed areas. Adaptive social protection buffers immediate welfare losses and enables households to take productive

risks (like trying a new crop or sending a family member to the city for work) without fear of total ruin.

- **Adaptation strategies vary by gender:** Given the nature of their engagement in the labour market, it is crucial to recognise and address how climate change and adaptation measures affect women and men differently. Gender gaps in education, land rights, and mobility influence who can adapt and how.

Conclusion

Fostering human capital is a win-win strategy for development and climate adaptation. Education and skill-building equip individuals with the means to improve their economic prospects while making societies more adaptable to a changing climate. However, these measures must be paired with efforts to remove barriers preventing people from relocating or switching jobs and incorporate protections for those still at risk. Climate change will increasingly demand a fundamental shift in how and where we work. By acting now to invest in people – and supporting them as they transition to new opportunities – policymakers in low- and middle-income countries can help ensure that the most vulnerable are not left behind in the face of climate change. An integrated approach that links education, mobility, urban planning, social protection, and gender equity will build more resilient communities and a more sustainable future in a warming world.