



DEEP THEMATIC PAPER 4

# Ending extreme poverty in a changing climate

Amanda Lenhardt

August 2023



THE WORLD BANK



Oxford Policy  
Management



Cornell University

UNIVERSITY OF  
Southampton

UNIVERSITY OF  
COPENHAGEN



## About DEEP

Our mission is to build evidence, insights, and solutions that help end extreme poverty globally.

We aim to contribute to new global and national data and evidence that governments, decision makers, citizens and researchers can use to improve people's lives and support the world's poorest people in their efforts to escape extreme poverty.

We are a consortium of the Universities of Cornell, Copenhagen, and Southampton led by Oxford Policy Management, in partnership with the World Bank's Development Data Group and funded by the UK Foreign, Commonwealth & Development Office.

**How to cite:** Lenhardt, A (2023) 'Ending extreme poverty in a changing climate', DEEP Thematic Paper 4, Data and Evidence to End Extreme Poverty Research Programme, Oxford.

**Available at:** <https://doi.org/10.55158/DEEPTP4>

Follow the programme here:



## Questions:

- **How is climate change expected to affect efforts to eradicate extreme poverty by 2030?**
- **What are the most important gaps in evidence on how to reduce extreme poverty in a changing climate?**

## Summary

The impacts of climate change are widely recognised as being among the leading threats to the eradication of extreme poverty. Climate change is not only expected to keep people currently living in poverty trapped there, but also threatens to cancel out progress that has been made to reduce poverty. The multiplier effect of climate change interacting with other drivers of poverty is expected to lead to a range of challenges for poor, and near poor, households (Hallergate et al., 2014; Jafino et al., 2020; Olsson et al., 2014). The links between climate change and poverty are therefore of increasing concern for many multilateral, bilateral, government, and non-government agencies – who are increasingly shifting their strategic focus.

The complex links between climate change and poverty eradication now feature in the mainstream discourse and evidence of their two-way relationship has been building. This is helping to inform strategies to cohesively address climate change and extreme poverty. Significant gaps remain, though, and interventions to address goals climate and environmental goals have received less attention than other Sustainable Development Goals, such as those for health and education (Snilstveit et al., 2017).

This paper explores how climate change is expected to affect efforts to reduce extreme poverty by 2030. It has two primary objectives. First, to provide a high-level summary of the latest well-evidenced research on measures to address extreme poverty in a changing climate. Second, to identify priority areas where further research could add value. It is a non-systematic review of the leading drivers between poverty and climate change, the current body of evidence on measures to address these drivers, and well-documented evidence gaps. The report draws on peer-reviewed academic research, grey literature, blogs from leading institutions and thinkers, and interviews with thought leaders. This paper aims to identify evidence and literature gaps that might be filled by the Data and Evidence to End Extreme Poverty (DEEP) project, with a focus on DEEP priority countries (Bangladesh, Ethiopia, India, Madagascar, Mozambique, Myanmar Nigeria, and Tanzania). It also introduces principles for the prioritisation of research on policies and programmes with potential to promote extreme poverty reduction more generally.

### **How climate change is expected to affect efforts to eradicate extreme poverty by 2030**

The channels through which climate change affects extreme poverty are well documented. The reverse of this relationship – how poverty affects efforts to address climate change – is increasingly coming into focus as more actors join the commitment to addressing climate change. Direct and indirect channels include:

- The channel between agriculture, climate change and extreme poverty is perhaps the best understood, with the impoverishing effects of slow- and rapid-onset climate events receiving significant attention. Smallholder farmers experiencing poverty, a

group particularly exposed to the impacts of climate change, have also increasingly been seen as prospective custodians of more sustainable agricultural systems. This has led to calls for more investment to support their role in combatting climate change (Ki-Moon, 2021).

- Impacts in urban settings have come into greater focus, particularly the impacts of climate-related disasters, as their frequency and severity has increased. The poorest people tend to live in the most precarious housing, have less access to services, and are often employed in sectors vulnerable to the impacts of climate change (Olsson et al., 2014; Moda et al., 2019).
- Evidence on climate change and health is still emerging, but the relationship is well supported and concern for this is on the rise. People living in extreme poverty are more exposed to health risks than those that are not, and ill health is a well-known cause of impoverishment (Shepherd et al., 2014). Sudden-onset shocks, such as floods, heatwaves, and forest fires, and slow-onset impacts from increased temperatures, air pollution, and new disease vectors, lead to loss of life, injury, trauma, chronic illness, and mental health effects (Heaviside, 2019).
- The disproportionate impacts of climate change on the poorest people, and in the poorest countries, shows the injustice of the crisis – those least responsible for climate change are the worst affected. And, from a pragmatic view, those at the forefront of climate change face the highest economic constraints to adapting – let alone mitigating – its impacts. Calls for just transitions to low-carbon economies and greater donor support to help those impoverished by climate change have opened new channels for investment (UN Climate Change Conference UK 2021).

The relative importance of each of these channels differs according to country context, as does the magnitude of their impacts on extreme poverty. Looking at future climate vulnerability and projected poverty rates up to 2030 in DEEP priority countries, some stand out for prioritising new and better evidence:

- Madagascar is ranked the most vulnerable and least ready to adapt to climate change. Among the DEEP priority countries, it is also predicted to have the third highest number of people in extreme poverty by 2030. Evidence gaps also appear to be significant for Madagascar.
- Bangladesh ranks as the next most vulnerability, after Madagascar, among DEEP priority countries. The availability of evidence is also low in Bangladesh.
- Nigeria is ranked very high in terms of vulnerability to climate change and lack of capacity to adapt to it. Among DEEP countries, future poverty is projected to be highest in Nigeria. Addressing the risk of impoverishment due to the impacts of climate change will be critical to meeting global poverty reduction targets.

## Leading evidence on how to reduce extreme poverty in a changing climate

A summary of available evidence includes:

- Leading areas for policy intervention include agricultural extension, risk mitigation and land use policies. Some interventions have less supporting evidence, however, and it remains unclear on how to best extend them to poor farmers, (Lopez-Avila et al., 2017; Snilstveit et al., 2016).
- There is a strong, if incomplete, evidence base on the role of cash or asset transfers in protecting the poor from shocks and stresses, the prevention of impoverishment and promotion of resilience, according to reviews on the evolution of social protection policies in the context of climate change (Costella et al., 2021; Tenzing, 2020).
- On the mitigation side, energy policies are one area that has been extensively explored, and where a large share of climate finance is directed. Fossil fuel subsidy reforms to free up resources for public spending on poverty reduction has been a common approach adopted by countries (Couharde & Mouhoud, 2020; Coady et al., 2015).
- Since the 1990s, payment for environmental service programmes (PES) have been invested in as a means of combining mitigation with poverty reduction. Their popularity continues to grow. Despite this, evidence on their effectiveness is relatively limited and has been deemed of low quality (Blundo-Canto et al., 2018; Snilstveit et al., 2019).
- The relationship between biodiversity, conservation and poverty reduction is widely cited, and numerous goals and targets have been set in this area. Evidence on effective strategies is limited, however (Roe et al., 2014; Cooper, 2020; Puri et al., 2016).
- The potential impact of climate and disaster risk insurance on extreme poverty is an area that has seen significant interest. There is clear demand for greater evidence, though thus far research has been limited, in part due to challenges in measurement (Panda & Surminski, 2020).
- Of the topics discussed in this paper, the causal chain between climate change, ill-health, and extreme poverty is perhaps the least understood. We know that the poorest are the most exposed to ill-health caused by climate change, and that ill-health is a leading cause of impoverishment, but evidence on effective interventions along this causal change is scarce (Hess et al., 2014).

## Background

The relationship between poverty and climate change has become a 'defining issue of our time' (Hallegatte et al., 2016). According to Delia Paul:

Both poverty and unsustainable patterns of production and consumption are key drivers of environmental degradation. At the same time, environmental degradation and climate change can drive poverty. While there is no easy solution, poverty and the environment must be addressed together (2021, p.2).

The importance of this relationship has been broadly understood for some time. Large-scale efforts to promote change are relatively recent, however, and evidence of the effectiveness of such interventions is only beginning to emerge (Paul, 2021). Meanwhile, the pace of technological change over the last 15 years, the falling costs of transitioning to net-zero, and recent political and private sector engagement have introduced new opportunities to address the complexity of this relationship (Stern, 2021).

Modelling exercises tell us that the magnitude of the effects of climate change on future poverty are likely to be significant. Using an exploratory modelling approach, Jafino et al. (2020) estimate the effects of various combinations of climatic and socioeconomic uncertainties on the range of possible drivers of climate change that are likely to impact poverty in the future. Alongside both optimistic and pessimistic scenarios of future economic growth, their research explores five ways climate change may impact poverty: agricultural productivity and output prices; food consumption prices; exposure to, and losses from, natural disasters; impacts on labour productivity; and impacts on health and nutrition (Jafino et al., 2020, p.3). Their average estimate across scenarios is 313.5 million people living in extreme poverty by 2030, with a best-case scenario of 9.3 million (Jafino et al., 2020, p.4). Shepherd et al., (2013) produce similar results using the International Futures model that draws on internationally representative demographic, economic, energy, agricultural, socio-political, and environmental systems data for 183 countries. They project up to 325 million extremely poor people will be living in the 49 most hazard-prone countries in 2030. They also predict that the countries with the largest number of people living in poverty, while also facing multiple hazards and inadequate capacity to minimise impacts, will be Bangladesh, Democratic Republic of Congo, Ethiopia, Kenya, Madagascar, Nepal, Nigeria, Pakistan, South Sudan, Sudan, and Uganda.

### Climate change, chronic poverty, and impoverishment

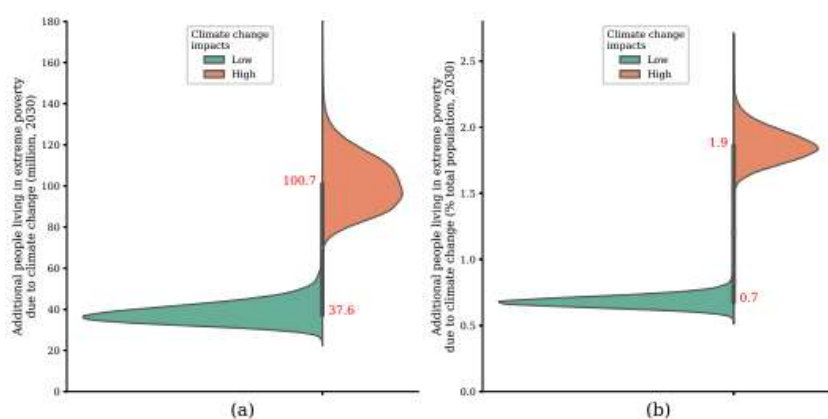
Climate change has the potential to drive future impoverishment and reinforce chronic poverty. On the one hand, there is a risk that those living just above the poverty line that are exposed to the damaging effects of climate change will fall into poverty (Olsson et al., 2014). Repeated shocks are also likely to have gradual, long-term impoverishing effects:

People who are poor and marginalized usually have the least buffer to face even modest climate hazards and suffer most from successive events with little time for recovery. They are the first to experience asset erosion, poverty traps, and barriers and limits to adaptation (Ibid, p.802).

On the other hand, those already living in extreme poverty have been the hardest hit by climate change and will likely continue to be. They will therefore struggle to escape poverty. The persistence of chronic poverty, defined as ‘extreme poverty that persists over years or a lifetime that is often transmitted intergenerationally’ (Shepherd et al., 2014; Olsson et al., 2014). Evidence from India and Kenya that explores the longer-term effects of natural hazards on child poverty identified direct effects on individual and household deprivation, injuries, and death – each contributing to longer term impoverishment (Diwakar et al., 2019). Other indirect effects include impacts on services and wider systems such as health, nutrition, water, sanitation, and education (Diwakar et al., 2019). A study drawing on consumption-based surveys and long-term climate data for 24 countries in sub-Saharan Africa found long-term temperature and flood shocks to be significantly welfare decreasing, with particular significance for total household expenditure, per capita food expenditure, and the likelihood of being poor (Azzarri et al., 2020, p.6).

For households that do manage to escape poverty, and for those living slightly above the poverty line, the risk of falling back into poverty due to climatic shocks remains high (Diwakar et al., 2018; Jafino et al., 2020; Olsson et al., 2014). There is growing recognition, through research on poverty dynamics, that gains in extreme poverty reduction can be cancelled out by descents back into poverty. Programmes and policies seeking to address extreme poverty, however, often fail to take this into account (Shepherd et al., 2014). Modelling by Jafino et al (2020) reveals that an additional 100 million people could be pushed into poverty by 2030 due to climate change in a worst-case scenario, cancelling out gains in poverty reduction (see Figure 1).

**Figure 1: People pushed into extreme poverty due to climate change in 2030, a) absolute number; b) % of population**



Source: Jafino et al., 2020, p.5



With climate change among the leading factors for future impoverishment, the need for preventative programming will become ever more pressing as part of the agenda to eliminate extreme poverty. Shepherd et al. point out:

Governments rarely prioritise the prevention of impoverishment, preferring more positive agendas, such as achieving sustained economic growth. Given the increased frequency of extreme weather events and the continued economic vulnerability of many least developed countries, this neglect must be reversed (2014, p. 6).

These trends are also likely to drive increased inequality as those at the bottom of the distribution stay trapped or get pushed further down, while those at the top face less exposure and maintain greater capacity to adapt to a changing climate (Islam & Winkel, 2017). Evidence shows that those facing marginalisation – women, minority ethnic groups, children, older people, and others – experience climate change more acutely (UN DESA, 2016). There is also evidence that suggests a two-way, endogenous, relationship between inequality and climate change, where countries with higher levels of inequality also have higher greenhouse gas emissions (Islam & Winkel, 2017).

### **Links between climate change and other drivers of extreme poverty**

Climate change has become a feature of many people's everyday lives and therefore frequently interacts with other drivers of poverty. The impacts of climate change in rural areas, particularly those that depend on agriculture, is linked to rural-urban migration. Unpredictable weather patterns and both slow and sudden-onset disasters have impacted rural livelihoods, pushing people to migrate both within their countries and sometimes abroad. In doing so, climate migrants are seeking to mitigate the economic impact of these shocks and searching for more resilient economic opportunities. Climate change also affects different groups in different ways, with harmful social norms<sup>1</sup> often being exacerbated when households are struck by climate crises. When households' livelihoods are disrupted, coping strategies that are harmful may involve removing girls from school, engaging them more in household work or resorting to marrying girls young. And where climate shocks impact fragile contexts these can fuel conflict and insecurity by exacerbating existing tensions.

---

<sup>1</sup> Harmful social norms, understood applying a welfare approach, are social norms considered harmful when they result in net welfare losses, as compared to the welfare that would result from their absence.

## Channels between climate change and poverty

### Agricultural losses and unsustainable practices

Climate change has a direct impact on farming and farm-related livelihoods by affecting crop yields and the viability of raising livestock (Olsson et al., 2014). These then impact other rural economic activities, such as farm labour, as well as sectors that are dependent on farm incomes (Ibid). Such income and livelihood losses can both inhibit escapes from poverty and lead to impoverishment. In addition, impacts on agriculture can have indirect effects across multiple dimensions of wellbeing. Climate change can indirectly affect extreme poverty through deprivations in other dimensions of wellbeing such as food security, nutrition, health, and access to education.

Low-income households are more likely to rely on less favoured lands that are more susceptible to low productivity and degradation, with less access to infrastructure and markets (see Barbier & Hochard, 2018 for a review of the evidence). According to Shepherd et al.:

The environment that poor people inhabit [is becoming] either peripheral or polluted, over-populated or subject to increasing natural disasters... and poor people do not have the power to make any decisions about the use of space they inhabit (2014, p. 22).

This clearly inhibits poverty reduction efforts. But it also means that those most exposed to climate change have the least resources to invest in adaptation and mitigation, and the least say in changes that affect them and for which their knowledge could have a significant impact.

As land degradation persists in agricultural areas, along with other natural resource depletions, such as water and biodiversity, migration is likely to increase as people are pushed from unproductive areas (Olsson et al., 2014). Clement et al. (2021) estimate that as many as 216 million people could be internal climate migrants by 2050, with the largest expected to be in the poorest and most climate-vulnerable regions in sub-Saharan Africa.

### Adaptation challenges in urban areas

It is well established that climate change and extreme weather events lead to the erosion of financial assets and non-agricultural livelihood opportunities in urban and peri-urban areas. Olsson et al. point out that:

Damage to physical assets due to weather events is well documented for poor urban settlements, often built-in risk-prone floodplains and hillsides susceptible to erosion and landslides... [and] in poor areas... is often followed by displacement due to loss of property" (2014, p.804-805).

In Dhaka in Bangladesh, informal settlements are more likely to be built in areas prone to natural hazards (Islam & Winkel, 2017, p. 13). Rural migrants moving to Antananarivo Madagascar often settle in areas that are flood prone (USAID, 2018b, p. 3). Women in low-income households have been disproportionately affected by flooding in Lagos, Nigeria (Ajibade et al., 2013). The livelihoods of poor urban residents are also more likely to be dependent on sectors vulnerable to climate change, such as construction, with workers being exposed to increasing temperatures (Moda et al., 2019).

There are also indirect channels between climate change, disasters and extreme poverty in urban areas. These include health impacts, disruptions to basic services, and lost human and social capital. Exposure to extreme heat, for example, is predicted to have an uneven impact on the urban poor who live in low-quality housing in informal settlements. It has been estimated that, by the middle of the century, 215 million poor people living in urban areas will be exposed to average summertime temperatures of over 35C (C-40 Cities, 2018). Climate-related natural disasters are also linked to migration and internal displacement from and within cities, leading to direct and indirect impacts on extreme poverty. Jafino et al.'s (2020) modelling estimates the impacts of natural disasters are predicted to lead to 6.1 million to 18.2 million people being pushed into poverty globally.

### **Impoverishing health impacts**

Ill health is known to be a frequent cause of impoverishment and people living in poverty are more exposed to health risks (Shepherd et al, 2014). It is also well known that those living in poverty are at heightened risk of climate-induced ill health. Air pollution, for example, which is responsible for 6.5 million deaths per year, mostly affects children and older people in low-income countries, particularly in urban areas. Currently, 98% of urban areas in low-income countries do not meet accepted air quality standards (Gordon et al., 2017, p.918). While these links are well evidenced and widely discussed, the full causal chain between climate change, ill health and extreme poverty, and what kinds of interventions may work best, receive less attention in the literature (Hess et al., 2014).

Jafino et al.'s, (2020) modelling predicts that health factors related to the changing climate will have the largest impact on future poverty rates. They estimate child stunting, malaria and diarrhoea could push 25 to 44 million people into poverty by 2030. The second most important factor according to the model will be rising food prices, which are tipped to lead to 4.2 to 33.5 million people being pushed into poverty. Price increases are predicted to be particularly poverty-inducing in sub-Saharan Africa and South Asia; whereas health will be the most important factor in East Asia and the Pacific, as well as Latin American and the Caribbean.

## Climate change and poverty in DEEP focus countries

The latest evidence predicts that, without significant course correction, DEEP priority countries will maintain some of the highest rates of extreme poverty by 2030. They are also among the most vulnerable to, and ill-prepared for, climate change. Table 1 summarises global climate vulnerability rankings for the eight priority countries from the Notre Dame Global Adaptation Initiative (ND-GAIN), recent projected poverty rates using the International Future model from Abidoye et al., (2021), and the leading climate risks in each country according to a comprehensive set of country-level risk studies conducted by USAID (note Myanmar was not included) including the areas that these risks are anticipated to most impact.

**Table 1: Climate vulnerability and projected poverty rates in DEEP priority countries**

Country	Vulnerability and Readiness to adapt (ND-GAIN) <sup>1</sup>	Projected extreme poverty headcount (millions) <sup>2</sup>	Climate Projections <sup>3</sup>	Climate Impact Areas <sup>3</sup>
Madagascar	165/182	24	Increased Frequency/Intensity of Extreme Weather Events; Increased Precipitation Unpredictability/Variability; Increased; Temperature	Agriculture, Fisheries, Coastal ecosystems, Human health, Water
Bangladesh	164/182	4.6	Increase in rainfall Intensity, Flood Incidence, and Cyclone Intensity & Incidence; Increased Temperature	Agriculture and food security, Ecosystems, Energy, Human Health, Water Resources
Myanmar	162/182	0.2	Not available	Not available

Nigeria	161/182	110	Increased Frequency/Intensity of Extreme Weather Events; Sea Level Rise; Increased Temperature	Agriculture, Energy, Human Health, Urban Areas
Ethiopia	155/182	17	Increased Frequency/Intensity of Extreme Weather Events; Changes to Season Duration/Seasonal Precipitation; Increased Temperature	Agriculture, Livestock, Human health, Water
Mozambique	154/182	24	Increased Incidence of Dry Spells/Droughts & Increased Heat Wave Duration; Increased/More Frequent Precipitation; Sea Level Rise; Increased; Temperature	Agriculture, Coastal Resources, Human Health, Water
Tanzania	147/182	24	Increased Incidence of Dry Spells/Droughts & Increased Heat Wave Duration; Increased/More Frequent Precipitation; Sea Level Rise; Increased; Temperature	Agriculture, Ecosystems, Energy & Infrastructure, Human Health, Water Resources
India	121/182	51	Increased Severity of Droughts & Heat Waves; Increased Flooding from Sea Level Rise and Extreme Precipitation Events; Increased Temperature	Agriculture, Ecosystems, Human Health, Water

1: ND-GAIN country rankings, Notre Dame Global Adaptation Initiative (2019); 2: Abidoye et al., 2021; 3: Climate Risk Profiles, USAID (various).

Of the eight DEEP countries, Madagascar is the most vulnerable to climate change and the least ready to adapt to it; according to projections, it will have the third-highest number of people living in extreme poverty by 2030. Evidence to support effective interventions around climate change and poverty reduction in Madagascar could be particularly influential. Bangladesh is not far behind, with the next highest vulnerability and limited capacities to adapt. Myanmar and Nigeria trail only slightly in terms of vulnerability to climate change and lack of capacity to adapt to it. In Nigeria, future poverty is projected to be highest among DEEP countries. Addressing the risk of impoverishment due to the impacts of climate change in Nigeria will be critical to meeting global poverty reduction targets.

## Evidence from leading policy and investment areas

Some areas stand out for the amount of attention they have received in the literature, particularly with regard to the number of impact evaluations and in-depth studies conducted for certain kinds of interventions in different contexts. This may be due to policy priorities in these areas channelling more interest and resources into their evaluation, though some areas may simply be more easily measured and therefore offer 'lower-hanging fruit' for researchers. No area covered in the following section can be deemed fully evidenced and some outstanding gaps are highlighted, though not all. Further evidence in these areas is likely to contribute more to their applicability in different settings and under different conditions.

### Extension of sustainable agricultural and land practices

There are clear relationships between climate change, agriculture and poverty. This has generated significant attention and much effort has been invested in determining effective sustainable agricultural practices and how to extend them to poor farmers. The majority of people living in extreme poverty live in rural areas and many remain reliant on small-scale agriculture. And despite efforts to reform economies into industrial and service sectors, the agricultural sector still accounts for a significant share of the GDP of many low-income countries. Improving the sustainability and profitability of agriculture has therefore been a longstanding priority for policy and research. Development in this area cuts across commitments related to poverty reduction, food security, nutrition, health and sustainable resource management. It is therefore indirectly linked to many other sustainable development commitments.

Systematic reviews and evidence gap maps have been produced on the impacts of a range of intervention and their effects on extreme poverty. These include climate-smart agriculture and innovation (Lopez-Avila et al. 2017; Rosenstock et al., 2019); land-use change and forestry programmes (Snilstveit et al., 2016); and input subsidies (Hemming et al., 2018). A systematic map of evidence on climate-smart agriculture in five countries in East and Southern Africa (Tanzania and Mozambique included from DEEP priority countries) identified 153 studies for inclusion, though the authors note that climate-smart agriculture interventions 'are subject to the priorities of farmers, communities and government where [they are] being implemented' and therefore suggest country-level evidence may not be generalisable in other contexts (Rosenstock et al., 2019, p. 142). Lopez-Avila et al. (2017) produced a gap map on agricultural innovations, finding that 'the largest grouping of impact evaluations is concentrated across interventions referring to the provision of inputs and practices, and outcomes related to productivity, such as yield and income' (p.ii).

The evidence base on effective interventions in this area is quite strong. Gaps remain, however, on the adaptability of interventions to different contexts and on how to disseminate practices to ensure they reaches those living in extreme poverty. Lopez-Avila et al. (2017) found that few studies on agricultural innovation measure how knowledge was transferred and highlight evidence gaps on cost effectiveness and spillover effects. Sniltveit et al.'s (2016) evidence gap map finds that secondary impoverishing impacts of climate change, such as food security, basic material, and health, are rarely studied in evaluations of land use change and forestry programmes. They also find gaps in certain intervention types, such as land rights, information services, and technical and vocational training.

### **Expansion of climate-focused social protection coverage**

Reviews on the evolution of social protection policies in the context of climate change have identified a strong, if incomplete, evidence base on the role of cash or asset transfers. The findings show transfers help to protect poor people from shocks and stresses, prevent impoverishment and promote climate resilient households (Costella et al., 2021; Tenzing, 2020). Social protection measures combined with climate mitigation and adaptation strategies have been found to contribute to enhanced food security, increased human capital, improved employment and income opportunities, immediate support in the face of shocks, and other poverty reducing outcomes.

Many DEEP priority countries have climate-focused programming within their social protection schemes. India's Mahatma Gandhi National Rural Employment Scheme has integrated climate responsive projects and targeted support across the programme. The Infrastructure for Climate Resilience Growth programme in the states of Bihar, Chhattisgarh and Odisha is focused on strengthening capacity and technical support for natural resource management, climate-resilient water harvesting, land development and soil conservation infrastructure. A recent evaluation of the programme shows:

Positive results, including stronger community engagement, better understanding of climate risks and assets that are climate responsive, more durable and easier to use. Farmers have been able to double their crops and continue irrigation even under drought, helping to increase income and savings, and to repay debts (Bharawdwaj, 2020).

Despite the relatively large amount of evidence in this area, there are remaining gaps in our understanding of how social protection programmes can be best applied to eliminate extreme poverty in a changing climate. One glaring gap is the question of scale – many countries still have low social protection coverage or have benefit packages that are too small to have a sustained impact on households' resilience. Further evidence is needed to support the design and financing of comprehensive social protection schemes that address the full range of climate risks facing those in or at risk of falling into extreme poverty (Costella et al., 2021). There is also 'inadequate understanding of intersectional inequalities



and how they relate to climate risks [that] limit the effectiveness of social protection interventions' Costella et al., 2021, p.24). Eskander and Steele (2019) find that in Bangladesh, for example, 'exposure to climate and disaster risks leads single women-headed households to spend three times as much of their savings for disaster related risk reduction activities as male headed households' (quoted in Costella et al., 2021, p.24). Further evidence is needed on the potential for social protection programmes to 'empower recipients and re-dress structural inequalities that are the social root causes of vulnerability to climate change' (Tenzing, 2020, p.11).

### Energy sector reforms

'Most experts consider a low-carbon energy transition to be inevitable' (Zinecker et al., 2018, p.1). Energy transitions have occurred in various forms in the past, and the potential impact on employment, prices, and regions dependent on outgoing industries has captured policy and research attention (Zinecker et al., 2018). The challenges of ensuring a 'just transition' in lower income countries – one that promotes fair economic, social, and environmental outcomes – are broadly known. And though evidence on just transitions has largely focused on higher income settings, recent research has sought to correct this (Zinecker et al., 2018).

Fossil fuel subsidy reforms have become a major policy area for low- and middle-income countries to contribute to climate change mitigation and evidence of the impacts of these reforms on poverty has been increasing (Couharde & Mouhoud, 2020; Coady et al., 2015). Fuel subsidies were historically promoted as a redistributive or price protection tool for lower-income households, however the efficiency of these policies and their contribution to climate change have led to widespread interest in phasing them out (Couharde & Mouhoud, 2020; Rentschler & Bazilian, 2016). Fuel subsidies have been found to be regressive, with the richest 20% of households capturing more than 6 times more fuel subsidies on average than the poorest 20% (Coady et al., 2015). Coady et al. estimate:

The cost to the budget of transferring one dollar [to the poorest 40%] via gasoline subsidies is about 14 dollars... this occurs because nearly 93 out of every 100 dollars of gasoline subsidies "leaks" to the top three quintiles. These leakages are higher in Africa and in Asia and Pacific, where poor households' use of gasoline and LPG is comparatively lower than in other regions. (2015, p. 12).

Outstanding evidence gaps in this area include the effectiveness of these measures to mitigate price shocks on different segments of the poor, the political economy challenges of reforms, and the contribution of these reforms to broader climate change policy packages (Rentschler & Bazilian, 2016, p. 906-907). Recent protests in diverse settings ranging from France to Brazil and Haiti highlight the sensitivities of imposing fuel subsidy reforms without public support or clear measures to mitigate the effects of these reforms on lower-income households and avoid exacerbating existing inequalities (Walnychki & Landesman, 2021).

## Payment for environmental services

PES programmes are market-based approaches that involve payments to farmers or landowners 'to take certain actions to manage their land or watersheds to provide an ecological service' (IIED, n.d.). They have proliferated in recent years, both as a conservation and resource management strategy and as an alternative livelihood opportunity for smallholder farmers and landholders (IIED, n.d.; Blundo-Canto et al., 2018). Activities may involve planting or maintaining existing trees, adopting sustainable agriculture techniques, and, more recently, involve conservation in coastal and marine ecosystems (IIED, n.d.). In DEEP priority countries, PES programmes include Mozambique's Nhambita Community Carbon programme; Tanzania's Equitable Payment for Watershed Services programme (Blundo-Canto et al., 2018; Snilstveit et al., 2019); India's payment for environmental services agreement between the Palampur Municipal Council and the Village Development Society (Dash, 2019); and mangrove conservation in the Baie des Assassins area of Madagascar (Rakotomahazo et al., 2021).

Despite PES programmes being trialled since the 1990s and their growing popularity, evidence on their effectiveness is relatively limited and has been deemed to be low quality (Blundo-Canto et al., 2018; Snilstveit et al., 2019). According to Snilstveit et al.:

The evidence base is too limited in both quantity and quality to be able to confidently establish the effectiveness of PES programmes on environmental and human welfare outcomes... The evidence that does exist is focused on a limited set of programmes and therefore limits the generalisability and applicability of the evidence (2019, p.100).

Furthermore, 'many PES schemes have reached implementation maturity slowly, limiting evaluation opportunities' (Blundo-Canto et al., 2018, p. 166).

Such programmes are also highly concentrated in Latin America, where some of the earliest pilots were introduced (Blundo-Canto et al., 2018; Snilstveit et al., 2019). From the two systematic reviews identified on this area, only two studies on Mozambique's Nhambita Community Carbon programme were identified and two on Tanzania's Equitable Payment for Watershed Services programme were identified; studies for the other eight countries were either not identified or included (Blundo-Canto et al., 2018; Snilstveit et al., 2019).

Topics recommended for further investigation to determine effective and efficient design of PES programmes include: programme effectiveness on a wider range of economic, social and environmental outcomes (including intermediate outcomes), social and cultural aspects of uptake and efficiency, institutional factors, different financing options, equity considerations, possible spill over effects, and evidence on newly emerging programmes in marine ecosystems (Blundo-Canto et al., 2018; Snilstveit et al., 2019; IIED, n.d.)

## Biodiversity loss, conservation, and poverty reduction

The relationship between biodiversity, conservation and poverty reduction has been on the policy agenda for decades, though evidence around effective strategies in this area appear to be limited (Roe et al., 2014; Cooper, 2020; Puri et al., 2016). Commitments to protect biodiversity and conservation due to their role in extreme poverty can be traced back at least as far as the Millennium Development Goals which included an indicator on land under protection for biodiversity. States also committed to develop national strategies to protect biodiversity at the Rio Earth Summit in 1992. These commitments are further reinforced by SDG 15, and while many countries have adopted measures in this area, progress is seen to be stalled on this indicator (UN DESA, n.d.).

A systematic mapping of evidence on the links between biodiversity and poverty found that few studies explicitly study these links, instead focusing on the consumptive use of biodiversity for subsistence and tradable purposes (Roe et al., 2014, p.12). An evidence gap map on the evidence for forest conservation interventions similarly found 'there is little or no high-quality evidence in areas that are otherwise significant for policy' (Puri et al., 2016, p. iii). Of the evidence available, biodiversity conservation programmes have been found to have both positive and negative effects on extreme poverty, with context, intervention, governance, and engagement found to be determining factors (Cooper, 2020).

PES is a common strategy that has been trialled to promote biodiversity and poverty reduction simultaneously, though the range of interventions and possible outcomes remain underexplored. Porras & Steele (2020) propose biocredits to finance pro-poor investments in biodiversity-enhancing actions and present examples where these credits have been used. But they also point out that better evidence and awareness is needed to make these initiatives more effective:

To really understand biocredits or other instruments that help manage biodiversity as an asset, it is necessary to move beyond the idea that using markets is counterproductive. It is likely that interest in incentive-type mechanisms such as biocredits will only grow. Done properly, biocredits can build on the shortcomings and successes of the global carbon trading markets and develop into a viable option to improve biodiversity and reduce poverty. (Porras & Steele, 2020. p.26)

Governance and management of process such as restrictions, capacity development and decentralisation are other areas that have been experimented with, though our understanding of their impacts remains weak (Cooper, 2020, p.13). For example, the promotion of community-based cultivation and market development of medicinal and aromatic plants in Indian Himalaya was found by one study to contribute to livelihoods and biodiversity, with further research needed on how to extend similar programming to other socio-economic and environmental contexts (Phondani et al., 2016).

## Climate and Disaster Risk Insurance

The potential impact of climate and disaster risk insurance on extreme poverty is an area that has seen significant interest and where there is demand for greater evidence. However, it is an area that has proven difficult to measure (Panda & Surminski, 2020). According to Shaefer and Waters:

Many actors are currently investing resources in developing and supporting climate risk insurance schemes and are looking for ways to implement insurance at a larger scale; many of these efforts are specifically targeted at covering the poor and vulnerable in developing countries (2016, p.8).

Furthermore, recent review by Panda and Surminski found that:

There is a clear gap between efforts to increase the scale of [climate and disaster risk insurance] and empirical evidence of success and failures on the ground. This arises partly because measuring and tracking input, output, outcome and impact is complex, and in most cases context specific. Another key challenge is the lack of transparent reporting and data collection in connection to the insurance schemes. (2020, p.3)

An evidence gap map on interventions to address risk for smallholder farmers found that index insurance was the most studied intervention, and more studies explored uptake of insurance as compared to outcomes such as changes in income. A notable exception is a systematic review on microinsurance that identified promising results related to reduced vulnerability of the poor and poverty escapes (Barooah et al., 2017, p. 20). The review found that India and Ethiopia are most represented in available evidence, so further research in this area could be more impactful in other DEEP priority countries. Two studies were identified from Mozambique and one from Nigeria but none from Bangladesh, Madagascar, Myanmar or Tanzania.

## Interventions in health, poverty, and climate change

The causal chain between climate change, ill health and extreme poverty is perhaps the least understood topic discussed in this paper. While the bipartite links between each of these challenges are broadly understood, policy and programming to address the full causal chain appears to be less developed. Yet Jafino et al. (2020) show in their modelling that among the different impact channels of climate change on extreme poverty, health has the largest impact on future poverty scenarios. This may be an area where further evidence generation could have a significant impact.

There are many possible intervention areas that could be considered along the climate-health-poverty chain. The impacts of air quality on people living in or near poverty is one area that has garnered attention, though evidence on interventions in this area, particularly in high pollution low-income countries, is limited (Anderson, 2017). The World Health Organization (WHO) has highlighted that higher air pollution among those living in extreme poverty can trap people in poverty through multiple channels:

People living in low and middle-income countries are typically more vulnerable to air pollution due to the higher levels... they are exposed to each day and their higher prevalence rates of diseases that are negatively affected by air pollution exposure, like asthma. Populations living in slums or near busy highways or roads, lacking access to clean cook, or in certain occupations are... more vulnerable to the adverse impacts of air pollution... Energy poverty thus locks people in a vicious cycle, sapping them of time, damaging their health, and limiting their access to better livelihoods, education, and other paths out of poverty. (WHO, 2022)

Exposure to disease is another channel that has been explored, with those in extreme poverty often more exposed to diseases with links to climate change (i.e. malaria and diarrhoea through waterborne diseases) and for which poverty traps can occur through this exposure (UNDESA, 2016, p.37). According to United Nations Department of Economic and Social Affairs (UNDESA):

People living in poverty... live closer to malaria-breeding grounds. Further, they have more limited access to piped water sources, which forces them, during floods, to drink water containing pathogens. For example, residents of low-income slums in Mumbai have indicated greater levels of flooding during the monsoon season, resulting in an increase in the number of reports of disease outbreaks. In the wake of the 1998 floods in Bangladesh, there were higher reported rates of diarrhoea among groups with lower income, lower levels of education and lower-quality housing without access to tap water (2016, p. 37).

## References

- Abidoye, B., Felix, J., Kapto, S. & Patterson, L. (2021). Leaving No One Behind: Impact of COVID-19 on the Sustainable Development Goals (SDGs). New York, NY and Denver CO: United Nations Development Programme and Frederick S. Pardee Center for International Future
- Ajibade, I., McBean, G. & Bezner-Kerr, R. (2013). Urban flooding in Lagos, Nigeria: Patterns of vulnerability and resilience among women. *Global Environmental Change*, 23(6), p.1714-1725.
- Anderson, R. (2017). Implications for the science of air pollution and health. *The Lancet Respiratory Medicine*, 5(12).
- Barbier, E. & Hochard, J. (2018). The Impacts of Climate Change on the Poor in Disadvantaged Regions. *Review of Environmental Economic and Policy*, 12(1).
- Barooah, B., Kaushish, B., Puri, B. & Leach, B. (2017). Understanding financial agricultural risk for smallholder farmers in developing countries: what do we know and not know? 3ie Evidence Gap Map Report 9. International Initiative for Impact Evaluation (3ie): London. <https://www.3ieimpact.org/evidence-hub/publications/evidence-gap-maps/understanding-financial-agricultural-risk-smallholder>
- Bharadwaj, R (2020). Are India's social protection schemes 'future fit'? IIED: London. <https://www.iied.org/are-indias-social-protection-schemes-future-fit>
- Blundo-Canto, G., Bax, V., Quintero, M., Cruz-Garcia, G., Grownveld, R. & Perez-Marulanda, L. (2018). The Different Dimensions of Livelihood Impacts of Payments for Environmental Services (PES) Schemes: A Systematic Review. *Ecological Economics*, 419 (2018), 160-183.
- Breisinger, C., Mukashov, A., Raouf, M. & Wiebelt, M. (2019). Energy subsidy reform for growth and equity in Egypt: The approach matters. *Energy Policy*, 129, p.661-671.
- C-40 Cities (2018). The future we don't want: How climate change could impact the world's greatest cities. UCCRN Technical Report. [https://www.c40.org/wp-content/uploads/2021/08/1789\\_Future\\_We\\_Dont\\_Want\\_Report\\_1.4\\_hires\\_120618.original.pdf](https://www.c40.org/wp-content/uploads/2021/08/1789_Future_We_Dont_Want_Report_1.4_hires_120618.original.pdf)
- Clement, V.; Rigaud, K.; de Sherbinin, A.; Jones, B. Adamo, S.; Schewe, J.; Sadiq, N.; Shabhat, E. (2021). Groundswell Part 2: Acting on Internal Climate Migration. World Bank, Washington, DC. <https://openknowledge.worldbank.org/handle/10986/36248>

Coady, D., Flamini, V. & Sears, L. (2015). The Unequal Benefits of Fuel Subsidies Revisited: Evidence for Developing Countries. IMF Working Paper WP/15/250.

<https://www.imf.org/external/pubs/ft/wp/2015/wp15250.pdf>

Cooper, R. (2020). Biodiversity conservation and restoration, and poverty reduction. K4D Helpdesk Report 773. Brighton, UK: Institute of Development Studies.

[https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/15180/773\\_Biodiversity\\_conservation\\_and\\_restoration\\_and\\_Poverty\\_Reduction.pdf?sequence=1&isAllowed=y](https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/15180/773_Biodiversity_conservation_and_restoration_and_Poverty_Reduction.pdf?sequence=1&isAllowed=y)

Costella, C., McCord, A., van Aalst, M., Holmes, R., Ammoun, J., & Barca, V. (2021) Social protection and climate change: scaling up ambition. Social Protection Approaches to COVID-19 Expert Advice Service (SPACE), DAI Global UK Ltd.

<https://socialprotection.org/discover/publications/space-social-protection-and-climate-change-scaling-ambition>

Couharde, C. & Mouhoud, S. (2020). Fossil fuel subsidies, income inequality and poverty: evidence from developing countries. *Journal of Economic Surveys*, 34(5), p.981-1006.

Dash, A. (2019). Payment for Ecosystem Services: Palampur in Himachal has a model in place. DownToEarth News. <https://www.downtoearth.org.in/news/environment/payment-for-ecosystem-services-palampur-in-himachal-has-a-model-in-place-65908>

Diwakar, V., Lovell, E., Opitz-Stapleton, S. Shepherd, A. & Twigg, J. (2019). Child poverty, disasters and climate change: Investigating relationships and implications over the life course of children. ODI: London. <https://cdn.odi.org/media/documents/12618.pdf>

Dwyer, s., Johnson, Z. & Zühr, R. (2020). Financing for the future: climate finance and the role of ODA. Donor Tracker Insights. <https://donortracker.org/insights/financing-future-climate-finance-and-role-oda>

Gass, P. & Echeverria, D. (2017). Fossil Fuel Subsidy Reform and the Just Transition: Integrating approaches for complementary outcomes.

Gordon, S., Mortimer, K., Grigg, J. & Balmes, J. (2017). In control of ambient and household air pollution. *The Lancet Respiratory Medicine*, 5(12).

Hallegatte, S., Banglaore, M., Bonzanigo, L., Fay, M., Narloch, U., Rozenberg, J. & Vogt-Schilb, A. (2014). Climate Change and Poverty. Policy Research Working Paper 7126. World Bank Group.

<https://openknowledge.worldbank.org/bitstream/handle/10986/20639/WPS7126.pdf?sequence=1&isAllowed=y>

Hallegatte, S., Banglaore, M., Bonzanigo, L., Fay, M., Narloch, U., Rozenberg, J., Treguer, D. & Vogt-Schilb (2016). Shockwaves: Managing the impacts of climate change on poverty. World



Bank: Washington, D.C.

[https://www.gfdrr.org/sites/default/files/publication/Shock\\_Waves.pdf](https://www.gfdrr.org/sites/default/files/publication/Shock_Waves.pdf)

Heaviside, C. (2019). Understanding the Impacts of Climate Change on Health to Better Manage Adaptation Action. *Atmosphere*, 10(119).

Hemming, D., Chirwa, E., Ruffhead, H., Hill, R., Osborn, J., Langer, L., Harman, L., Coffey, C., Dorward, A. & Phillips, D. (2018). Agricultural input subsidies for improving productivity, farm income, consumer welfare and wider growth in low- and middle-income countries: A systematic review. *3ie Systematic Review* 41. <https://www.3ieimpact.org/evidence-hub/publications/systematic-reviews/agricultural-input-subsidies-improving-productivity>

Hess, J., Eidson, M., Tlumak, J., Raab, K. & Luber, G. (2014). An Evidence-Based Public Health Approach to Climate Change Adaptation. *Environmental Health Perspectives*, 122(11), p.1177-1186.

IEA, OECD & World Bank. (2010). The scope of fossil fuel subsidies in 2009 and a roadmap for phasing out fossil fuel subsidies. Paris: IEA, OECD/Washington DC: World Bank. <https://www.oecd.org/env/cc/46575783.pdf>

IIED (n.d.) Markets and payments for environmental services. IIED Project. <https://www.iied.org/markets-payments-for-environmental-services>

Islam, S. & Winkel, J. (2017). Climate Change and Social Inequality. DESA Working Paper 152. United National Department of Economic and Social Affairs: New York. [https://www.un.org/esa/desa/papers/2017/wp152\\_2017.pdf](https://www.un.org/esa/desa/papers/2017/wp152_2017.pdf)

Jafino, B., Walsh, B., Rozenberg, J. & Hallegatte, S. (2020). Revised estimates of the Impact of Climate Change on Extreme Poverty by 2030. Policy Research Working Paper 9417. World Bank Group. <https://documents1.worldbank.org/curated/en/706751601388457990/pdf/Revised-Estimates-of-the-Impact-of-Climate-Change-on-Extreme-Poverty-by-2030.pdf>

Ki-Moon, B. (2021). Smallholder farmers provide the key to tackling the climate crisis. The Independent, 15 October 2021. <https://www.independent.co.uk/climate-change/opinion/hunger-poverty-climate-crisis-food-small-farmers-b1938239.html>

Lopez-Avila, D., Husain, S., Bhatia, R., Nath, M. & Vinayagam, R. (2017). Agricultural innovation: an evidence gap map. *3ie Evidence Gap Map Report* 12. International Initiative for Impact Evaluation (3ie): New Delhi. <https://www.3ieimpact.org/evidence-hub/publications/evidence-gap-maps/agricultural-innovation-evidence-gap-map>

Moda, H., Filho, W. & Minhas, A. (2019). Impacts of Climate Change on Outdoor Workers and Their Safety: Some Research Priorities. *International Journal of Environmental Research and Public Health*, 16(18): 3458.



Olsson, L., Opondo, M., Tschakert, P., Agrawal, A., Eriksen, S., Ma, S., Perch, L. & Zakieldeen, S. (2014). Livelihoods and poverty. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C., Barros, V., Dokken, D., Mach, K., Mastrandrea, M., Bilir, T., Chatterjee, M., Ebi, K., Estrada, Y., Genova, R., Girma, B., Kissel, E., Levy, A., MacCracken, S., Mastrandrea, P. & White, L. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832. [https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap13\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap13_FINAL.pdf)

Panda, A. & Surminski, S. (2020). Climate and disaster risk insurance in low-income countries: Reflections on the importance of indicators and frameworks for monitoring the performance and impact of CDRI. Centre for Climate Change Economic and Policy Working Paper No. 377. <https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2020/09/working-paper-348-Panda-Surminski.pdf>

Paul, D. (2021). Merging the Poverty and Environment Agendas. IISD Earth Negotiations Bulletin 11. IISD Winnipeg. <https://www.iisd.org/system/files/2021-02/still-one-earth-poverty-and-environment.pdf>

Phillips, D., Coffey, C., Tsoli, S., Stevenson, H, Evers, J., White, H. & Snilstveit, B. (2017). A map of evidence maps relating to sustainable development in low- and middle-income countries. 3ie Evidence Gap Map Report 10. International Initiative for Impact Evaluation (3ie): London. <https://www.3ieimpact.org/sites/default/files/2017-12/egm-brief-map-of-map.pdf>

Phondani, P., Bhatt, I., Negi, V., Kothiyari, B., Bhatt, A. & Maikhuri, R. (2016). Promoting medicinal plants cultivation as a tool for biodiversity conservation and livelihood enhancement in Indian Himalaya. *Journal of Asia-Pacific Biodiversity*, 9(1), p.39-46.

Porras, I. & Steele, P. (2020). How biocredits can protect biodiversity and reduce poverty. IIED Issue Paper. IIED: London. <https://pubs.iied.org/sites/default/files/pdfs/migrate/16664IIED.pdf>

Puri, J., Nath, M., Bhatia, R. & Glew, L. (2016). Examining the evidence base for forest conservation interventions. Land-use change and forestry programmes: evidence on the effects on greenhouse gas emissions and food security. 3ie Evidence Gap Map Report 3. International Initiative for Impact Evaluation (3ie): New Delhi. <https://www.3ieimpact.org/evidence-hub/publications/evidence-gap-maps/examining-evidence-base-forest-conservation>

Rakotomahazo, C., Razanoelisoa, J., Ranivoarivelo, N., Todinanahary, G., Ranaivoson, E., Remanevy, M.E., Ravaoarinosihoarana, L., & Lavitra, T. (2021). Community Perceptions of

a Payment for Ecosystem Services Project in Southwest Madagascar: A Preliminary Study. *Land*, 10 (597).

Rentschler, J. & Bazilian, M. (2016). Reforming fossil fuel subsidies: drivers, barriers, and the state of progress. *Climate Policy*, 17(7), p.891-914.

Roe, D., Fancourt, M., Sandbrook, C., Sibanda, M., Giuliani, A., & Gordon-Maclean, A. (2014). Which components or attributes of biodiversity influence which dimensions of poverty? *Environmental Evidence*, 3(3).

Rosenstock T., Lamanna C., Namoi N., Arslan A., & Richards M. (2019) What Is the Evidence Base for Climate-Smart Agriculture in East and Southern Africa? A Systematic Map. In: Rosenstock T., Nowak A., Girvetz E. (eds) *The Climate-Smart Agriculture Papers*. Springer, Cham

Shaefer, L. & Water, E. (2016). Climate risk insurance for the poor & vulnerable: how to effectively implement the pro-poor focus of insurresilience. Munich Climate Insurance Initiative.

[https://collections.unu.edu/eserv/UNU:5956/MCII\\_CRI\\_for\\_the\\_Poor\\_and\\_Vulnerable\\_meta.pdf](https://collections.unu.edu/eserv/UNU:5956/MCII_CRI_for_the_Poor_and_Vulnerable_meta.pdf)

Shepherd, A., Scott, L., Mariotti, C., Kessy, F., Gaiha, R., da Corta, L., Hanifnia, K., Kaicker, N., Lenhardt, A., Lwanga-Ntale, C., Sen, B., Sijapati, B., Strawson, T., Thapa, G., Underhill, H. and Wild, L. (2014) *The chronic poverty report 2014–2015: The road to zero extreme poverty*. ODI: London.

Shepherd, A., Mitchell, T., Lewis, K., Lenhardt, A., Jones, L., Scott, L., Muir-Wood, R. (2013). *The geography of poverty, disasters and climate extremes in 2030*. ODI: London.  
<http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8633.pdf>

Snilstveit, B., Stevenson, J., Villar, P., Eyers, J., Harvey, C., Panfil, S., Puri, J. & McKinnion, M. (2016). Land-use change and forestry programmes: evidence on the effects on greenhouse gas emissions and food security. 3ie Evidence Gap Map Report 3. International Initiative for Impact Evaluation (3ie): London. <https://www.3ieimpact.org/evidence-hub/publications/evidence-gap-maps/land-use-change-and-forestry-programmes-evidence>

Stern, N. (2021). A time for action on climate change and a time for change in economics. Centre for Climate Change Economics and Policy Working Paper No. 397.  
<https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2021/10/working-paper-370-Stern.pdf>

Tenzing, J. (2020). Integrating social protection and climate change adaptation: A review. *WIREs Climate Change*, 11(2).

UN Climate Change Conference UK 2021. Supporting the condition for a just transition.

<https://ukcop26.org/supporting-the-conditions-for-a-just-transition-internationally>

UN Department of Social and Economic Affairs (UN DESA) (n.d.). Sustainable Development Goals: 15. <https://sdgs.un.org/goals/goal15>

UN DESA (2016). World economic and social survey 2016. E/2016/50/Rev.1

[https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESS\\_2016\\_Report.pdf](https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESS_2016_Report.pdf)

USAID (2019). Climate Risk Profile Nigeria. USAID Fact Sheet.

[https://www.climatelinks.org/sites/default/files/asset/document/2019\\_USAID-ATLAS-Nigeria-Climate-Risk-Profile.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID-ATLAS-Nigeria-Climate-Risk-Profile.pdf)

USAID (2018a). Climate Risk Profile Bangladesh. USAID Factsheet.

[https://www.climatelinks.org/sites/default/files/asset/document/2018-02-Mar\\_CadmusCISF\\_Climate-Risk-Profile-Bangladesh.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2018-02-Mar_CadmusCISF_Climate-Risk-Profile-Bangladesh.pdf)

USAID (2018b). Climate Risk Profile Mozambique. USAID Factsheet.

[https://www.climatelinks.org/sites/default/files/asset/document/2018\\_USAID-ATLAS-Project\\_Climate-Risk-Profile-Mozambique.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2018_USAID-ATLAS-Project_Climate-Risk-Profile-Mozambique.pdf)

USAID (2018c). Climate risks in urban and urbanizing geographies – Madagascar. USAID Climate Risk Profile. [https://reliefweb.int/sites/reliefweb.int/files/resources/2018\\_USAID-ATLAS\\_Climate-Risk-in-FFP-Geographies-Madagascar.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/2018_USAID-ATLAS_Climate-Risk-in-FFP-Geographies-Madagascar.pdf)

USAID (2018d). Climate Risk Profile Tanzania. USAID Factsheet.

[https://www.climatelinks.org/sites/default/files/asset/document/20180629\\_USAID-ATLAS\\_Climate-Risk-Profile-Tanzania.pdf](https://www.climatelinks.org/sites/default/files/asset/document/20180629_USAID-ATLAS_Climate-Risk-Profile-Tanzania.pdf)

USAID (2017). Climate Risk Profile India. USAID Factsheet.

[https://www.climatelinks.org/sites/default/files/asset/document/2017\\_USAID%20ATLAS\\_Climate%20Risk%20Profile%20-%20India.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile%20-%20India.pdf)

USAID (2016). Climate Change Risk Profile Ethiopia. USAID Factsheet.

[https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Factsheet%20-%20Ethiopia\\_use%20this.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Factsheet%20-%20Ethiopia_use%20this.pdf)

Walnycki, A. & Landesman, T. (2021). Can we reduce urban poverty and inequality and achieve net zero cities? International Institute for Economic Development:

London. <https://www.iied.org/can-we-reduce-urban-poverty-inequality-achieve-net-zero-cities>

WHO (2022). Air quality and health: Equity impacts of air pollution.

<https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/equity-impacts>