# Resilience of what and for whom? An analytical framework to assess climate change mitigation and adaptation interventions in the coffee sector

By Janina Grabs[1], Stefano Ponte[2], Kristjan Jespersen[3], Caleb Gallemore[4]

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[1]Escuela Superior de Administración y Dirección de Empresas (ESADE), [2,3]Copenhagen Business School (CBS), [4]Lafayette College

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## Project context

The PACSMAC project is a 5-year collaboration between Copenhagen Business School, the University of Dar es Salaam, Jimma University, Lafayette College, and ESADE Business School. The project aims to investigate how climate change – and the ways actors across the value chain are trying to adapt to or mitigate it – affect coffee farmers' livelihoods and land-use decisions. Work package 1 is dedicated to understanding: 1) How might climate change itself, alongside the mitigation and adaptation efforts intended to address it, affect the governance of coffee value chains originating in Ethiopia and Tanzania? And 2) How do these changes affect the distribution of value along the chain, upgrading opportunities and farmer livelihoods?

This working paper provides a literature review of relevant previous work and outlines an analytical framework to assess the impacts of top-down and bottom-up interventions.

## Introduction

Climate change threatens smallholder livelihoods across the Global South. Coffee growers, whose crop is very sensitive to temperature and precipitation change, are especially at risk. Global warming may reduce yields, shrink optimal growing areas, and foment more frequent and widespread pest and disease outbreaks (Kweka and Ouma 2020; Pham et al. 2019). Arabica cultivation is under particular pressure, with Robusta less threatened (Bunn et al. 2015; Craparo et al. 2015). Regardless of their cultivar, smallholder coffee growers have limited capacity to adapt to climate-related challenges (Quiroga et al. 2020). Given that millions of smallholder farmers rely on coffee production for their livelihoods, they will have to adapt to changing growing conditions and/or to switch partly or wholly from coffee production to more suitable crops and other livelihood options. In this field, value chain collaborations, strengthened farmer-buyer relationships, and cross-sectoral partnerships have become increasingly important – with the putative aim at improving farm-level resilience and support farmer entrepreneurialism (Dentoni et al. 2021; Kangogo et al. 2020; Manyise and Dentoni 2021; Rosenstock et al. 2020).

In response to this impetus, government agencies, coffee roasters and traders, and development-focused NGOs are experimenting with adaptation and mitigation innovations. These include new cultivars, climate-smart farming techniques and new land use strategies (Fischersworring et al., 2015, Todo & Takahashi, 2013). These experiments' success, side effects, and benefits, however, will depend on how the entire value chain responds. Historically, coffee value chains have featured substantial power asymmetries, which facilitated extractivist business practices, with the lion's share of economic benefits accruing in the Global North (Daviron and Ponte 2005; Grabs and Ponte 2019). These power asymmetries could cause climate adaptation and mitigation innovations to produce paradoxical results. On the one hand, climate-smart agriculture could facilitate value chain upgrading – helping some coffee farmers differentiate themselves and more added value or better market access (Birkenberg et al. 2021; Gereffi and Lee 2016). On the other hand, adaptation and mitigation programs could make smallholders even more dependent on lead firms for inputs, expertise and market connections. The priorities of outside actors may also not be in line with the livelihood priorities of small farmers. To date, little empirical work has been done that would help stakeholders anticipate and address such paradoxical outcomes. This working paper offers an analytical framework on how to think of climate resilience, mitigation and adaptation actions at multiple levels – including the global coffee industry, national coffee sectors, coffee-growing communities, and individual farming households. Ultimately, we seek to delineate whether and how climate-related interventions are helpful to – or hinder – livelihood improvements on the ground.

## Literature review

### *Climate change, mitigation, and adaptation in the coffee sector*

A major focus of the literature on climate change in the coffee sector has been on modeling future climatic changes, coffee trees' physiological responses (DaMatta et al. 2018), and projected impacts on growing regions (Pham et al. 2019). Such studies have been conducted on global (Bunn et al. 2015; Kath et al. 2022), regional (Jaramillo et al. 2011; Ovalle-Rivera et al. 2015; Tolessa Lemma and Gudisa Megersa 2021), national (Camargo 2010; Moat et al. 2017), and even subnational scales (Benti Chalchissa et al. 2022; Benti et al. 2022). These studies show that climate impacts are likely variable, but may include yield losses, the loss of coffee-optimal areas, and the increase of pest and disease occurrence in most major coffee-producing areas (Pham et al. 2019).

A second stream of research has focused on assessing coffee farming communities' climate change perceptions, vulnerability to climate change, and initial responses, mostly via single case studies (Bacon et al. 2017; Guido et al. 2020; Mbwambo et al. 2021; Rahn et al. 2014; Temba et al. 2020). Climate change adaptation can happen

through spontaneous actions by farmers or via organized programs and support strategies. Increasing temperatures and erratic rainfall, assuming no change to planted cultivars, may force producers to seek higher altitudes, potentially sparking land conflict, deforestation, and other socio-economic and socio-ecological pressures (Ovalle-Rivera et al., 2015; Todo et al., 2011). Farmers may also use other adaptation actions such as the use of more resistant cultivars, intercropping, irrigation, or a shift to alternative crops (Gezie 2019; Temba et al. 2020). While some recent studies address more organized measures of adaptation such as the promotion of climate-smart coffee, most existing knowledge addresses only agronomic strategies to support production (Jaramillo et al. 2011, Läderach et al. 2017, Pham et al. 2019), including the importance of producing resilient cultivars (van der Vossen et al., 2015) and the adoption of agroforestry systems (Gomes et al. 2020).

Finally, while the coffee sector is a minor contributor to global emissions, research on climate change mitigation in the sector has focused on quantifying carbon emissions in coffee production and processing (Kilian et al. 2013; Nab and Maslin 2020), identifying ways to reduce net emissions (van Rikxoort et al. 2014), and highlighting the carbon sequestration potential of shaded coffee systems (Andrade and Zapata 2019). This literature further highlights that some practices, such as the planting of trees along farm boundaries and the restoration of degraded areas with coffee agroforestry systems, have high synergies between climate change mitigation and adaption (Rahn et al. 2014). Initial studies have assessed the willingness to pay of consumers for climate-neutral coffee (Birkenberg et al. 2021) as well as the success factors behind the first cooperative that achieved a carbon neutrality certification for its coffee (Birkenberg and Birner 2018).

A few studies have also aimed to make the link between corporate CSR programs and climate action. Bianco (2020) proposed that climate change adaptation might be considered 'Creating Shared Value' for coffee companies as it would support farmers as well as safeguarding supply. When reviewing five individual coffee companies' CSR initiatives related to climate adaptation, however, he finds little evidence of corporate action in this realm. Bradley and Botchway (2018), in turn, find that 7 out of the 10 companies they study report indicators related to climate change. The most comprehensive survey of company action to date, Bager and Lambin (2020), concluded that in the cross-section of companies (n=513) that they surveyed, climate change remains under-addressed.
Overall, the literature on climate change impacts, mitigation and adaptation in the coffee sector to date has tended to approach this topic through a biophysical and agronomic lens; has taken either a macro (large-scale modeling) or micro (single case study) approach; and has been disconnected from the equally voluminous literature on power, inequality, and value appropriation in global value chains. In addition, to the best of our knowledge, there has been no global assessment of institutional support projects. To enrich this perspective, we draw on and bring into conversation two additional literatures: The literature on climate vulnerability and resilience in farming systems, and the literature on upgrading in global value chains.

### *Climate vulnerability and resilience at various levels*

As van der Lee et al. (2022) point out, the broader literature on climate vulnerability and resilience in farming systems has taken a variety of lenses. While most authors agree with Walker et al. (2004)'s definition of resilience as "the capacity of a system to absorb perturbations or disturbances and reorganize while undergoing change, so as to still retain essentially the same function, structure, identity, and feedbacks", analytical foci vary broadly. Carpenter et al. (2001) suggest in this context to specify "the resilience of what to what", and van der Lee et al. (2022) expand this inquiry to ask the following questions:

1. Resilience of what: What is the scale of the system that should be resilient? (e.g. farm household, farming system, production activity, or larger scale system such as the supply chain, value chain, or food system)

2. Resilience to what: What perturbations are of relevance? (e.g. production disturbance; environmental, land and water perturbations; natural disasters and extreme weather events; climate change; food insecurity and poverty; global drivers and context changes market and supply chain changes; policy changes; others)
3. Resilience for what purpose: What purpose does resilience serve? (e.g. ecosystem services; food production; livelihood)
4. What is the outcome of resilience? (e.g. stability, transformation, or reduced vulnerability)
5. What factors are hypothesized to contribute to resilience? (e.g. capacities [further distinguished in capacity types, such as absorptive, adaptive, transformative], practices, resources, others)

Van der Lee et al. (2022) show that depending on the lens used, some elements may be given higher or lower importance. For instance, the *traditional lens* focuses most on ensuring system stability and highlights the importance of resources and adaptive capacity. The *agroecology lens* places the greatest focus on practices related to diversity and redundancy as conditions for adaptability and system stability. The *vulnerability lens* highlights the importance of improving a system's adaptive capacity, i.e. "the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences", to reduce vulnerability, via practice changes and resources. The *capacities lens* also foregrounds the importance of absorptive capacity ("the capacity of individuals, households, and/or communities to moderate the impacts of shocks on their livelihoods") and transformative capacity ("the capacity to create a fundamentally new system when shocks in ecological, economic, or social structures make the existing system untenable") in addition to adaptive capacity. The review makes clear that the literature is divided on the question whether the goal of resilience should be solely system stability, or whether system transformation should also be considered. It also highlights that it matters at which level we focus our analysis.

At the farm household level, some authors such as Dorward et al. (2009) distinguish between the livelihood strategies of 'hanging in', 'stepping up', and 'stepping out' that poor people may pursue to improve their livelihoods in the face of recurrent shocks. This simple distinction recognizes the dynamism and diversity of livelihood activities and strategies, and is explicitly cross-sectoral. According to this distinction, in *hanging in* strategies, "assets are held and activities are engaged in to maintain livelihood levels, often in the face of adverse socio-economic circumstances"; in *stepping up* strategies, "current activities are engaged in, with investments in assets to expand these activities, in order to increase production and income to improve livelihoods"; while in *stepping out* strategies, "existing activities are engaged in to accumulate assets which in time can then provide a base or 'launch pad' for moving into different activities that have initial investment requirements leading to higher and/or more stable returns" (Dorward et al. 2009, pp. 242–43). It should however be noted that the reality might be more complex. For instance, stepping out can also be determined by farmers not being able to participate in value chains because, for example, increasing demands (including those for sustainability). Farmers may also engage in partial stepping out, where they decrease their cultivation of coffee, for example, in view of waiting for better times (in terms of prices or access to capital) while partly differentiating in other crops or livelihood activities.

### *Upgrading in global value chains and its relation to climate resilience*

Of particular relevance to the 'stepping up' strategy is the way in which commodity producers can improve the value of their cash crop sales (Hulke et al. 2021; Vicol et al. 2019). This challenge is covered in depth in the global value chain literature. The global value chain (GVC) approach is widely used in political economy and development studies. It takes a meso-level lens and sees the global economy as a "complex and dynamic economic network

made up of inter-firm and intra-firm relationship[s]" (Gereffi 2014, p. 10). Its unit of analysis is the global value chain, defined as "all of the various activities, processes and actors that are linked together to produce any given good or service, from initial inputs of raw materials, through manufacturing, transportation and distribution, and on to marketing, retailing, consumption and final disposal" (Brewer 2011, p. 310). Besides the governance of chains and power dynamics between actors, a central research question in this literature is how value is generated and appropriated at each step of the chain, and how producers in the Global South might appropriate a higher share of the value of the final product – a process termed 'economic upgrading' (Ponte et al. 2019). Some authors distinguish between product, process, functional, and inter-sectoral upgrading (Humphrey and Schmitz 2002), but others highlight other upgrading possibilities, including the reversal of power hierarchies (when producers succeed in reshaping governance structures and manage to capture a larger share of value (Blažek 2016; Patel-Campillo 2011)) and relational upgrading (when firms achieve better positionality in production networks thus improving their 'know-who', in addition to their 'know-how' (Glückler and Panitz 2016; Krishnan 2017). Finally, Ponte (2019) employs three slightly different broad categories of upgrading: (1) *improving product, processes, volume and/or variety* (in the same value chain node); (2) c*hanging and/or adding functions* (up- or downstream; across several nodes); and (3) *transferring capabilities between chains* (applying competences acquired in a chain and using them in a different sector/chain).

In addition to economic upgrading, the GVC literature has also developed the concepts of environmental upgrading ("a process by which value chain actors design or modify production systems and practices in view of improving the environmental impacts of GVC operations" (Krishnan et al. 2022; Marchi et al. 2013, p. 65)) and social upgrading ("the process of improving the rights and entitlements of workers as social actors and enhancing of the quality of their employment" (Barrientos et al. 2011; Gereffi and Lee 2016, p. 26)). Empirical research on voluntary sustainability standards and certification schemes has aimed to ascertain to what extent such standards have achieved environmental and social upgrading, and whether they were able to link it to economic upgrading (e.g. to process upgrading via better agricultural practices, or product upgrading via the creation of new 'sustainable' attributes). In the case of coffee, results are mixed at best. The majority of studies find that environmental and social improvements are contingent on the type of certification scheme as well as national and local contexts, while economic benefits have declined over time as certification schemes have aimed to scale up and access mainstream markets (DeFries et al. 2017; Dietz et al. 2022; Grabs 2020; Oya et al. 2018).
In recent years, the most promising way for coffee producers to attempt to improve their farm-gate prices has been to target the high-quality specialty coffee sector (Borrella et al. 2015; Vicol et al. 2018). Yet, only a small share of the total crop output usually meets top quality requirements, and evaluations of quality change often, making this a risky strategy (Hernandez-Aguilera et al. 2018; MacGregor et al. 2017; Wilson 2013). In addition, only few producers tend to benefit, which may introduce competition, a breakdown of solidarity in coffee-producing communities, as well as a strengthening of the power and advantages of local elites (Fischer et al. 2021; Vicol et al. 2018). Recent studies have further found that high-quality coffee may be under special threat from climate change (Chemura et al. 2021). Yet, specialty coffee producers were simultaneously more likely to pursue on-farm climate adaptation strategies due to their motivation to maintain the quality of their coffee in response to global demand, and less likely than conventional farmers to choose crop diversification, off-farm activities and migration as adaptation options, pointing toward a complex relationship between climate change and coffee quality (Adane and Bewket 2021).

The most recent conceptual development has been the proposal to focus on livelihood upgrading, defined as "the application of upgrading concepts from the GVC literature towards potential livelihood improvements" (Neilson 2019, p. 299). Discussions in development research and policy have helped develop the Sustainable Livelihoods Approach as a comprehensive framework to conceptualize and promote people-centered development (Scoones

2009). While numerous development interventions explicitly target value-chain upgrading to alleviate poverty (Mayer and Gereffi 2019), whether or not product, process, functional or inter-sectoral upgrading will improve smallholders' livelihoods in any given case remains an open question (Howland et al. 2020; Neilson and Shonk 2014; Ponte and Ewert 2009). While upgrading might support higher incomes, smallholders face a tradeoff between diversified livelihood portfolios and specialization in a marketable commodity (le Polain de Waroux and Lambin 2013). Facing close survival margins, impoverished rural households also are often risk intolerant, while upgrading and market production often lead to high risk exposure (Loc et al. 2010). Recent advances have furthermore proposed that community co-governance of global value chains and an acknowledgement of small-scale agrarian systems is essential to ensure that upgrading actually enables 'stepping up' strategies and benefits local livelihoods (Gammelgaard et al. 2021; Hulke et al. 2021). This complex interface between upgrading strategies and livelihood improvements is a highly promising area of future study.

In Table 1, we provide an overview of all definitions and examples relevant to the coffee sector.

| Upgrading concept | Definition | Example |
|---|---|---|
| *Economic upgrading* | the process by which economic actors move from low-value to relatively high-value activities in global production networks (Gereffi et al. 2005) | Coffee producers (and/or their cooperatives) receive better prices or a better overall income from their coffee producing activities |
| - Product upgrading | moving into more sophisticated product lines (which can be defined in terms of increased unit values) (Humphrey and Schmitz 2002) | Coffee producers (and/or their cooperatives) produce higher-quality coffee or coffee with sustainability attributes (e.g. certification) that receive a premium |
| - Process upgrading | transforming inputs into outputs more efficiently by reorganizing the production system or introducing superior technology (Humphrey and Schmitz 2002) | Coffee producers (and/or their cooperatives) increase their yields while reducing the amounts and costs of inputs by adopting good agricultural practices |
| - Functional upgrading | acquiring new functions (or abandoning existing functions) to increase the overall skill content of activities (Humphrey and Schmitz 2002) | Actors in coffee-producing countries moving into roasting, packaging, and branding coffee to sell directly to consumers |
| - Inter-sectoral upgrading | firms of clusters move into new productive activities (Humphrey and Schmitz 2002) | Coffee producers (and/or their cooperatives) also produce other high-value goods (e.g. nuts) |
| - Improving volume and/or variety | combination of product and process upgrading as above, but also including delivering more volume and/or a variety of qualities (Ponte 2019) | Coffee producers (and/or their cooperatives) also deliver higher volumes and/or a variety of different qualities of coffee |
| - Reversal of power hierarchies | reshaping governance structures and manage to capture a larger share of value for the same kind of product (Blažek 2016; Patel-Campillo 2011) | Coffee cooperatives obtain fair trade certifications |
| - Relational upgrading | achieving better positionality in production networks thus improving their 'know-who', in addition to their 'know-how' (Glückler and Panitz 2016; Krishnan 2017) | Coffee growers (and/or their cooperatives) forge new contacts with buyers, for example through 'direct trading' relationships |
| *Environmental upgrading* | a process by which value chain actors design or modify production systems and practices in view of improving the environmental impacts of GVC operations (de Marchi et al. 2013) | Reducing the use of harmful herbicides, pesticides, water pollution, or carbon footprint associated with coffee production |
| *Social upgrading* | the process of improving the rights and entitlements of workers as social actors and enhancing of the quality of their employment (Gereffi and Lee 2016) | Introducing health and safety protection practices, ensuring living incomes for farm workers |
| *Livelihood upgrading* | the application of upgrading concepts from the GVC literature towards potential livelihood improvements (Neilson 2019) | Economic, social, or environmental upgrading activities allow producers to better sustain or improve upon their standard of living |

*Table 1: An overview of upgrading concepts and examples in the coffee sector*

## Analytical framework

We draw on the above outlined previous literature to develop an analytical framework for our study that is able to connect top-down projects and interventions focused on climate change mitigation and adaptation to their likely local-level impacts on upgrading and livelihood improvements.

In a first step, our framework responds to van der Lee et al. (2022)'s call for a holistic and multi-level approach to resilience by distinguishing between global, national sector, and local-level resilience to climate change (see image 1).

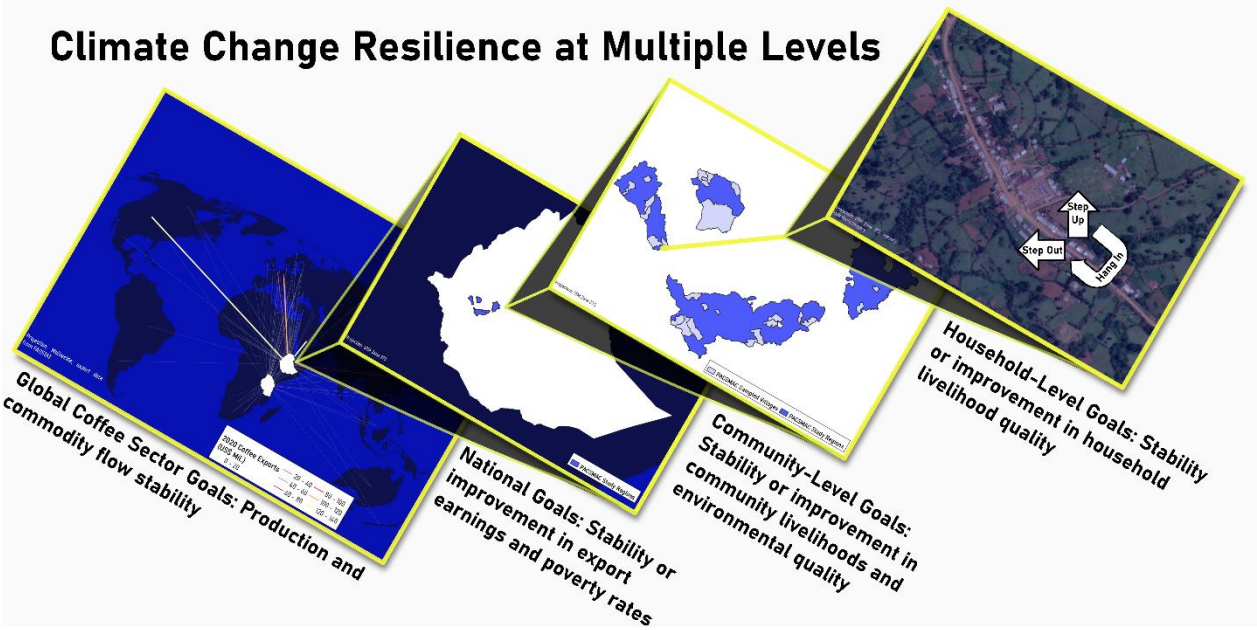


*Image 1: Climate change adaptation and resilience at multiple levels*

At each level, we then identify the major risks and purpose of resilience. The results of this exercise are represented in Table 2 below, where we showcase important differences between objectives and potential strategies toward climate resilience at different scales.

| **Resilience** | | | | |
|---|---|---|---|---|
| **Of what** | Global coffee industry | National coffee sector | Communities | Individual households |
| **To what** | Increased frequency of climate shocks, changes in long-term local outputs due to changing micro-climate | Climate shocks (see left) PLUS market and supply chain changes<br>PLUS policy changes | Climate shocks (see left)<br>PLUS market and supply chain changes<br>PLUS policy changes | Climate shocks (see left)<br>PLUS market and supply chain changes<br>PLUS policy changes<br>PLUS individual-level shocks (illness, crime, death of household members) |
| **For what outcome** | CROP PRODUCTION STABILITY:<br>Global supply that can meet current and future demand of coffee (w/ appropriate quality) | COMMODITY INCOME:<br>Maintenance or increase of commodity-related national income, foreign exchange generation, rural development, sector competitiveness | SUSTAINABLE LIVELIHOODS, ENVIRONMENTAL QUALITY:<br>Maintain or improve level and stability of community livelihoods, ensure environmental quality and access to resources (e.g. water, forest products) for all community members | SUSTAINABLE LIVELIHOOD:<br>Improve level and stability of livelihood outcomes in terms of food security, health, exit from poverty, life satisfaction |
| **Hypothesized processes** | - Ensure survival and increase productivity of many origins<br>- Flexible and diversified sourcing strategy<br>- Recommodification (incl. of specialty-grade) | - Ensure maintenance of coffee production in country<br>- Differentiation of national and local offer<br>- Decommodification (via specialty, Geographic Indications, sustainability) | - Aim for coffee upgrading via collective mechanisms (group formation, building of centralized processing infrastructure, group certification)<br>- Support diversification to decrease community dependency on coffee | - Choice of hanging in, stepping-up or stepping-out strategies depending on location, land size, assets and capabilities<br>- Decommodification OR diversification/exit |

*Table 2: Climate change resilience at multiple levels*

## Conclusion

A first major difference is that while climate change is the main source of instability that resilience aims to address at the global level, on the national and local level other sources of instability (including market, supply chain, and policy changes) are just as or even more important.

A second difference is that while it is vital for the resilience of the global and national coffee sectors that local producers keep producing coffee, this may not be a priority for resilience at a local level – if farmers can have an improved quality of life by moving out of coffee and into other types of income-generating activities, this might be preferable.

A final, third difference is that while upgrading is of high importance at the local and national level to ensure improved outcomes, it may be of lesser importance for global coffee market actors, whose main interest in terms of climate resilience is to ensure a continued, stable supply of coffee despite the likelihood of more frequent weather shocks and a decreasing suitability of existing coffee-growing regions. In response to these trends, coffee sector actors are likely to prefer a *recommodification* of the sector – i.e., a movement toward greater flexibility in switching between origins to allow for stable supply to consumers despite adverse weather events. This could be achieved through ensuring that producers 'hang in' existing crop production. In contrast, national and local actors are likely to prefer strategies of *decommodification* by setting their crop apart via improved quality, geographic or sustainability attributes which are key for product upgrading.

Drawing on Dorward et al. (2009)'s framework, we may define three possible types of climate-related interventions: Those that help producers *hang in* by ensuring that they are able to continue producing coffee in the same fashion as previously; those that help producers *step up* by linking the climate change mitigation or adaptation activities to receiving a higher value share through the various categories of economic upgrading; and those that support producers in *stepping out* of coffee by diversifying their income sources or switching to alternative crops.

We hypothesize that coffee industry actors would most commonly support *hanging in* interventions due to their interest in supporting long-term production, but might also support *stepping up* interventions to ensure that specific regions stay in coffee, especially in areas that are already well-known for their uniqueness and quality. Development organizations should, at least in theory, be interested in the community and individual household outcomes and should therefore either support stepping up or stepping out interventions (such as diversification or crop switching) depending on the individual and community characteristics. We further hypothesize that bottom-up interventions led by national-level sectoral actors would put the greatest emphasize on stepping up interventions by aiming to pursue various types of economic upgrading of coffee, while household or community-level adaptation practices are likely to be in the pursuit of livelihood upgrading and may include stepping up or stepping out strategies.

## Next steps

In a next step, we will apply this framework to our dataset of top-down interventions (see WP1.1. as well as to the country profiles and fieldwork data gathered in both Ethiopia and Tanzania.

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