



# Agriculture and climate resilience: Constraints and incentives

Mary Teddy Nakyejwe and Russell Morton

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## Introduction

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Although agriculture is central to the Ugandan economy—employing more than 68% of the working-age population—productivity in the sector remains significantly behind that of other sectors and its potential. Despite agriculture's large employment share, it contributes only 24% to Uganda's GDP. This discrepancy between agriculture's small GDP share and large employment share (not to mention the small export earning share at only 35%<sup>1</sup>)—emphasises unrealised potential in this vital sector. Moreover, commonly used agricultural productivity estimates<sup>2</sup> provide further evidence of opportunities for productivity growth. While Uganda has achieved higher productivity than some East African neighbours, such as Rwanda and Tanzania, Kenya and South Africa are 40% more productive. Additionally, other low- and middle-income (LMIC) countries such as Brazil, Ghana, and Thailand, feature agricultural productivity more than double that of Uganda. Consequently, improving agricultural productivity could yield significant direct benefits for the economy. Agricultural productivity improvements can also have indirect benefits by releasing labour to more productive sectors of the economy, such as services and manufacturing, which can support structural transformation.

In addition to opportunities for productivity improvement, agriculture in Uganda can make important advancements towards sustainability. Agriculture accounts for 25-30% of greenhouse gas emissions globally.<sup>3</sup> In Uganda, the sector plays an even more prominent role, contributing 46%, largely due to deforestation.<sup>4</sup> Therefore, the adoption of sustainable practices, such as agroforestry and improved manure management, could potentially decrease emissions by as much as 30% by 2050 (IPCC 2019). Promoting the take-up of new technologies and practices is central to strategies to mitigate the climate impact on agricultural production. Not only does agriculture affect climate, but climate change also has a reciprocal effect on the sector. Specifically, climate change can decrease agricultural productivity and profitability by creating heat stress, altering growing seasons, increasing climate variability, and causing both droughts and floods. Consequently, reducing the climate impact of agriculture is

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<sup>1</sup> International Trade Administration (<https://www.trade.gov/country-commercial-guides/uganda-agricultural-sector>)

<sup>2</sup> We define productivity as PPP-adjusted value-added-per-worker, using the GGDC Productivity Level Database (<https://www.rug.nl/ggdc/productivity/pld/releases/pld-2023>).

<sup>3</sup> Intergovernmental Panel on Climate Change (IPCC, 2019)

<sup>4</sup> World Bank (2021); Uganda: Systematic Country Diagnostic

vital not only broadly for reducing overall emissions but also for safeguarding the livelihoods of agricultural producers.<sup>5</sup>

We propose that it is essential to simultaneously address poverty and climate change in agricultural settings in Uganda; in other words, agricultural practices must be sustainable not only for the environment but also for the livelihoods of those working in the sector. The majority of Uganda's smallholder farmers are among the poorest in the world (FAO 2023). However, tackling climate change requires adaptation through costly investments. It follows that poverty can create a significant barrier for actors in agricultural value chains to change their behaviours and adopt more sustainable approaches to reduce future emissions, deforestation, and degradation. A lack of financial resources can directly limit access to investments required to improve both sustainability and profitability in the sector. And the native impacts of climate change on agricultural productivity only exacerbate this issue, further reducing agricultural value chain actors' ability to make these critical investments.

## Incentives and constraints: Effects on profitability and sustainability

Analysing the **incentives** and **constraints** that shape decision-making by farmers, traders, and agri-businesses throughout the supply chain provides valuable insights for two main purposes: *i*) understanding the current situation, and *ii*) designing policies to enhance agricultural profitability and sustainability. **Incentives** for an action (a behaviour, practice, investment, etc.) refer to the benefits that a decision-maker accrues from undertaking that action, while **constraints** refer to the barriers that prevent decision-makers from making a choice they might otherwise pursue, were the barrier not present.

In agricultural contexts, the primary incentives relevant to both profitability and sustainability are prices for agricultural products. Large quality premiums in world markets for many agricultural products that Uganda exports –such as cocoa, coffee, and cotton– motivate a special focus on how incentives (i.e., prices) for quality permeate through the supply chain, ultimately reaching farmers (or not). Notably, the quality premium is particularly significant for achieving the intertwined goals of improving both profitability and sustainability.

First, export markets often reward sustainable production practices, creating incentives for adopting such practices. Second, quality upgrading creates opportunities to enhance profitability sustainably without additional extensification and deforestation, even in settings when export markets do not

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<sup>5</sup> UNDP (2020); Climate Change and Agriculture: A Review of Impacts and Adaptation Strategies.

consider the environmental intensity of production as part of quality. On the other hand, constraints typically stem from numerous challenges that actors in agricultural value chains face when making investments that could improve both profitability and sustainability. We highlight a broad array of such constraints in more detail below, including the role of information constraints in limiting the adoption of practices for sustainable water harvesting.

Policies aimed at generating persistent improvements in the agricultural sector should address incentives, constraints, or both. To illustrate, farmers often face critical decisions about whether to adopt practices that could improve both profitability and sustainability. One such decision is whether to intercrop coffee with matooke. Intercropping can improve both sustainability, by reducing deforestation, and profitability, as many export markets offer a quality premium for shade-grown coffee. However, relatively low levels of intercropping observed suggest the presence of both incentive and constraint issues that are crucial for policy design. If farmers do not intercrop because the quality premium on world markets does not reach them, then policies should engage the supply chain directly to ensure incentives effectively reach farmers. On the other hand, if limited financial resources constrain farmers from planting matooke, then policies should address the credit barriers that farmers face. In other words, addressing the incentive problems alone, without also considering the constraints that shape behaviours, or vice-versa, is unlikely to produce desired results. Therefore, policies must be carefully tailored to target the specific incentives and constraints relevant to the particular setting. Moreover, in some settings, both incentive and constraint problems may simultaneously influence behaviour throughout the value chain.

Next, we explore specific incentive and constraint challenges, drawing on evidence from both Uganda and Sub-Saharan Africa as applicable. We conclude by demonstrating how incorporating both incentives and constraints into policy analysis can contribute to effective policy design.

## **Incentive problems in agricultural productivity and sustainability**

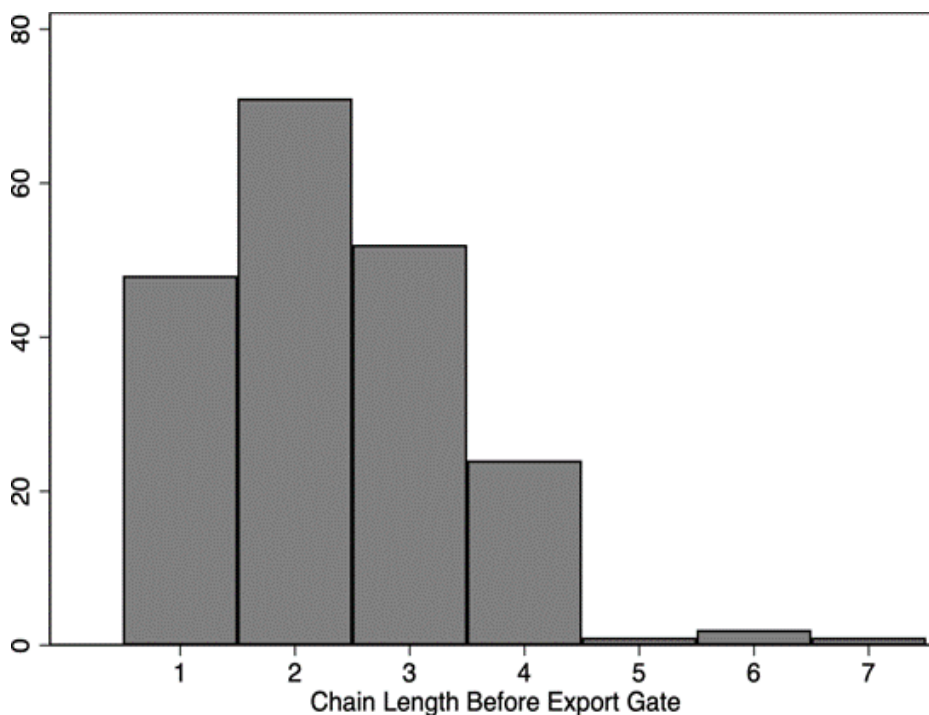
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In agricultural value chains, there are broadly two types of possible incentive problems relevant to both productivity and sustainability. First, there are incentive problems related to export markets not financially rewarding investments in productivity and sustainability. To address such incentive issues, coordinated policy action at the international level is likely necessary. Second, even when export markets do provide meaningful incentives for productivity and sustainability-enhancing behaviours, those incentives may not reach the domestic value chain. Since international policy coordination is beyond the

scope of this discussion, we focus on how incentives vary along the domestic supply chain.

Traders – and other intermediaries – between the export gate and farm gate can significantly shape the incentives within agricultural value chains. For example, in their study of domestic supply chains for coffee in the Rwenzori region, Bai et al. (2024) highlight the crucial role of intermediation: 85% of coffee flows through at least one trader before reaching an exporter and, on average, coffee changes hands three times (farmer, trader, exporter) before reaching world markets. (See Figure 1).

**Figure 1: Producers have limited direct access to exporters**



*Source: Quality Incentives and Upgrading in Uganda's Coffee Supply Chain; Bai, Bergquist, Morjaria, Morton, Tang, 2024.*

The **market** and **cost** structures of domestic supply chains influence the incentives that agricultural actors face. Market structure relates to the level of competition for products. While traders (and other intermediaries) may have significant cost advantages in transportation and aggregation, which can improve overall productivity (Grant & Startz, 2024), limited competition between them for farmers' production can reduce the prices paid to farmers. Limited competition can arise from several factors, including *i*) transportation, infrastructure, and distance limiting the geographies where traders operate; *ii*) collusive behaviour between traders; and *iii*) difficulties that traders face in identifying new producers in regions they do not know well. Evidence from

Uganda highlights how these search challenges can meaningfully affect prices. Specifically, the introduction of a new mobile platform (“Kudu”) which facilitates matches between farmers and traders increases the prices that farmers receive, particularly in areas with high production (Bergquist et al., 2024). The price increase, at least in part, reflects that additional traders enter these areas with high production, thereby increasing prices at farm-gates.

When limited competition reduces incentives for production, the agricultural value chain yields less total output and profit. Furthermore, a smaller share of the gains from production reach farmers, with traders capturing the majority of profits. This result reflects farmers responding to prices, as price reductions from low competition reduce the incentives for farmers to produce large quantities of output, further decreasing their profits. To address this, policies can target market structure, such as improving market integration by facilitating the entry of new intermediaries into markets. In addition, supporting farmers to directly access exporters could increase competition, as traders would then compete with exporters for farmers’ output.

Incentives can also derive from the *cost* structure of the supply chain, which refers to how the costs of undertaking productive actions vary along the supply chain. Bai et al. (2024) emphasise the importance of both cost and market structures in the context of coffee production in the Rwenzori region. For example, drying and sorting coffee are essential yet costly steps to improve coffee quality. When intermediaries incur lower costs to engage in these steps than farmers (i.e., intermediaries are more efficient at upgrading), they are often unwilling to pay a premium for coffee that has already been dried and sorted. As a result, incentives for high-quality coffee may stop at intermediaries, rather than reaching farmers. It is important to note that the significance of the cost structure applies broadly to any investments made by actors along the supply chain, including those that enhance sustainability.

While incentive problems due to the cost structure of the supply chain do not necessarily reduce total production by the supply chain, as they mostly shift which actor makes productive investments, they still have important policy implications. For instance, returning to the example of coffee in the Rwenzori region, policies aimed at increasing investments in quality to meet export market standards should take into account which actor in the value chain typically makes those investments. For example, subsidising inputs for farmers (such as sieves) to promote quality upgrading might not improve quality if traders engage in most upgrading (unless the subsidy is large enough to shift upgrading from traders to farmers). To maximise cost-effectiveness, policy design should carefully consider how to target the actor who can make the desired investment at the lowest cost.

## Constraint problems in agricultural productivity and sustainability

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Actors throughout agricultural value chains face a variety of constraints that limit, and even prevent, crucial actions to increase both profitability and sustainability. Broadly, constraints can be categorised into three main types: *i*) physical constraints, such as soil quality, water availability, and climate-related threats including rising temperatures and erratic precipitation; *ii*) economic constraints, including limited access to credit, insurance, and investment and inadequate transport infrastructure; and *iii*) technological and information constraints, which refer to the lack of knowledge about productivity- and sustainability-enhancing technologies, up-to-date price data, and accurate weather forecasts. Moreover, these constraints often interact and exacerbate each other. For instance, a farmer who faces physical constraints may experience low profits, which can create or amplify economic constraints.

### Examples of Constraints: Storage, Credit, and Information

Evidence from prior research underscores the importance of constraints, although we note that the examples highlighted below should not be considered an exhaustive list of all possible constraints.

First, storage constraints limit rural households' ability to profit from arbitrage opportunities created by seasonal price fluctuations. When farmers can store their harvest, they can sell their output when prices are high rather than low (Burke et al., 2018). However, credit constraints can lead farmers to sell at inopportune times, even when storage technology is available. For example, farmers may need to sell produce quickly to meet urgent cash needs, such as for school fees, health expenses, or consumption. In such cases, farmers often report selling at a low price and then purchasing the same produce later at a higher price (Stephens & Barrett, 2011). Furthermore, credit constraints can also prevent farmers from making investments that would improve both profitability and sustainability, even if there are incentives to make such investments.

In addition, Aker & Jack (2022) highlight the importance of information constraints in limiting the adoption of pro-sustainability practices in the context of a rainwater harvesting technique called *demi-lunes* in rural Niger. Specifically, farmers may lack knowledge about the existence of these techniques, how to implement them, or their associated costs and benefits (i.e., the incentives). They show that a one-day training session is sufficient to increase the likelihood of a farmer adopting *demi-lunes* for rainwater harvesting by over 90 percentage points. Notably, very few of the farmers who did not receive the training implemented any *demi-lunes*.

## Overcoming Constraints

Policies that address constraints can take two distinct approaches: either directly targeting the constraints themselves or supporting pre-existing market behaviours, firms, and institutions that mitigate them. Direct policies might include providing storage technology, financing, and training to tackle storage, credit, and information constraints.

Alternatively, policies may consider supporting pre-existing market actors, behaviours, and institutions that already play a role in alleviating constraints. For example, In Rwanda, many coffee buyers and suppliers have developed relationships that help overcome information constraints. The coffee buyer trains suppliers on key investments that improve both profitability and climate resilience (Abouaziza et al., 2024). Importantly, these relationships can also simultaneously address incentive problems (and not just assist with information constraints), as the buyer commits to rewarding specific investments. Therefore, policies that support these relationships - such as providing training to larger firms on clear and credible communication with their trading partners- may be cost-effective strategies to address constraints. Such policies leverage pre-existing market players who already have a deep understanding of the specific context that shapes farmer behaviour—including relevant incentives and constraints.

Other policies target the market institutions that play a crucial role in addressing key constraints. For example, the formal financial sector often provides insufficient credit to agricultural value-chain actors due to risks or administrative costs associated with smaller loan sizes. To address these challenges, policies could target constraints within the formal financial sector itself. Specifically, policies could include providing insurance to credit providers operating within agricultural value chains to reduce risk, as well as offering bonuses for small loan sizes to help overcome administrative costs associated with managing smaller loans. By leveraging the expertise and experience in credit origination and servicing that already exists within the formal financial sector, addressing economic constraints through the formal financial sector can be more cost-effective than direct interventions. An evaluation of the effectiveness of one such policy is currently underway, conducted in partnership with Aceli Africa.(Abouaziza et al., 2024). (See Figure 2)



Figure 2: Aceli Theory of Change



*Source: Finance for agricultural markets in Africa; Abouaziza, Bassi, Casaburi, Macchiavello, Nasir, 2024*

## Policy recommendations

1. **Identify** priority agricultural products at the intersection of four key categories to maximise attention on opportunities that promote both profitability and sustainability:
  - a) Export markets offer premia for sustainable production practices, thereby aligning production incentives with sustainability goals.
  - b) The cost of adoption of practices is likely lower than the quality premia in the export market, making it financially feasible for farmers to adopt the relevant practice while supporting their livelihood.
  - c) The product has broad relevance to Uganda, with special attention to the welfare of the poorest segments of the population. This focus ensures that the chosen products are well-positioned to improve livelihoods in vulnerable communities, which are often most affected by climate change.
  - d) The government is well-positioned to support export promotion, especially for sectors with low levels of current export activity. By targeting these sectors, the government can help improve market access and support both profitability and sustainability for farmers.

2. **Understand** the context-specific factors that shape incentives and constraints:

- a) Analyse prices along the value chain, with specific attention to how prices broadly, and the quality premium specifically, evolve along the domestic supply chain. This step will help to identify the likely location of incentive problems within the value chain.
- b) Evaluate productive investments throughout the supply chain to target policies towards value chain actors best positioned to adopt the relevant practice. By identifying these actors, policies can be more effectively tailored to yield the highest returns in terms of gains in agricultural productivity.
- c) Review constraint problems along the value chain, while considering solutions that can address incentive and constraint problems simultaneously. For example, higher prices can generate additional wealth, which, in turn, could alleviate credit constraints, thereby supporting further investment.

3. **Leverage** pre-existing value chain actors and market institutions, as appropriate and available, to maximise impact:

- a) Consider partnering with organisations that have a deep understanding of the local context and already are actively engaged in addressing both incentive and constraint problems. These partnerships can ensure that interventions leverage the expertise of current value chain actors.