

Financial Services and Logistics Innovation within Agri-food Value Chains: A Conceptual Framework

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Key Messages

- Finance and logistics services for agricultural value chains based on technological innovations exist in several LMICs, but they are not often extended to small holders or SMEs working in the agricultural midstream. We consider the constraints to adoption of those services faced by smallholders or SMEs.
- Finance and logistics improvements hold promise for increased employment, but research is needed to understand where employment gains are most likely.
- All value chain innovations must carefully consider possible equity-efficiency tradeoffs to ensure change does not negatively affect poor and vulnerable populations.

Catalyzed by changes to global markets, urbanization, and other trends, agri-food value chains have been growing and changing rapidly in low- and middle-income countries (LMICs) over the past few decades (Barrett et al., 2022). Perhaps more than ever, even in the world's poorest countries, farmers can access high-value consumer markets both domestically and abroad. Benefiting from access to these high-value markets, however, often requires that crops meet specific quality, reliability, and volume standards. In many cases, meeting such standards requires producers and intermediaries within the agri-food value chain to upgrade their production and logistics technologies. From an individual business perspective, these upgrades can require risky and/or relatively large investments, often facilitated by credit and other financial services. Small agri-food value chain actors—farmers, aggregators, traders, processors or others—that do not operate at a sufficient scale required for such investments may have limited access to these services, therefore hindering their ability to participate in such high-value markets.

Modern logistics services for agri-food value chains encompass activities such as supply chain management, transportation, traceability, digital platforms for e-commerce, and cold storage. While some modern logistics services exist in LMICs, the growth in firms moving food from farm to wholesale markets is often among small value chain actors (Reardon, Liverpool-Tasie, and Minten, 2021). SMEs may lack the ability to use newer tools to better manage the amount of product in supply chains or to ensure traceability which can leave logistics services underdeveloped. As a result, opportunities for high value growth may be limited. While some supply chain management and tracing applications have begun to emerge in LMICs, they often target larger farms, processors, or companies exclusively acting in high-value markets. But extending them to small value chain actors shows promise. Emerging logistic services using smartphone apps can improve traceability and therefore the assurance of food safety, particularly among perishables; they can link farmers or others with available products to new or different buyers; and they can democratize price information (e.g., Jensen, 2007; Aker 2010).

The further development of financial services for agri-food value chains in which smallholders participate can have similar benefits. If farmers have access to credit or liquidity at specific times in the production cycle, they can increase both their product quality and overall profitability. As a result, the volume and value of agricultural commodities moving through a specific agri-food value chain can increase. Similarly, if they can access price or weather insurance, farmers or producers may be able to take risks that they could not take otherwise. As with logistics, technology lends itself well to increasing the availability of finance (Aker and Mbiti 2010). Credit applications among producers can be enhanced or even collateralized using information on previous transactions (Bjorkegren and Grissen, 2020); mobile money can be used both as an efficient method of paying farmers, or as a savings vehicle (Bastian et al. 2018); and insurance products can use satellite data to improve risk models (Ceballos, Kramer, and Robles 2019). Finally, simply selling credit or insurance products on phones can also reduce transaction costs (Economides and Jeziorski 2015; Jack and Suri 2011).

Table 1 shows a stylized framework of possible innovations in financial and logistics services within agri-food value chains. For simplicity, we disaggregate a generalizable agri-food value chain into three levels: (i) farmers/producers, (ii) aggregators/traders, and (iii) processors/wholesalers. At the farmer/producer level, financial service innovations can include credit and insurance which may help overcome constraints stemming from fluctuations in liquidity and risks relating to productivity. Logistics innovations include systems that can help ensure that commodities meet reliability and quality standards demanded by consumers at the end of the value chain. At the aggregator/trader level, financial service innovations again can include credit and insurance, and can also include payment systems that allow for easier, more automatic processing and tracking of transactions—possibly between formal bank accounts. Logistics innovations at this level can include information systems to facilitate the dissemination of price information for both buyers and sellers, transportation infrastructure and services that can reduce costs associated with physically moving a commodity, cold storage facilities that can limit waste and spoilage, and systems that can enhance the transparency of sourcing to achieve reliability and quality standards. Finally, at the processor/wholesaler level financial service innovations can include payment and invoicing systems to automate billing. Additionally, with economies of scale some processors and wholesalers may be able to attract private investors to support the expansion of their businesses. Logistics innovations at the processor/wholesaler level can again include information systems and can also include supply chain management and shipping systems that essentially outsource transportation needs.

Table 1: Financial and Logistics Innovations Within Agri-food Value Chains

| Innovations | | |
|--------------------------------|---|---|
| Agri-food Value Chain Segments | Financial Services | Logistics |
| Farmers and/or producers | <ul style="list-style-type: none"> - (Digital) credit - (Digital) insurance | <ul style="list-style-type: none"> - Reliability - Quality standards |
| Aggregators and/or traders | <ul style="list-style-type: none"> - (Digital) credit - (Digital) insurance - (Digital) payments systems - Bank accounts | <ul style="list-style-type: none"> - (Digital) information - Transportation - Transparency - Cold storage |
| Processors and/or wholesalers | <ul style="list-style-type: none"> - (Digital) payments systems - (Digital) invoicing - Bank accounts - Private investors | <ul style="list-style-type: none"> - (Digital) information - Shipping - Supply chain management |

Source: Authors

While these emerging services are certainly a product of rapid growth in these markets, there are two important research angles we discuss below in more detail. First, as briefly discussed above, both logistics and finance services tend to be more available to larger producers as well as those with market power. Therefore, a key question is whether conditions exist to cost-effectively extend such services to smallholders, and if so, what characterizes those conditions. A related concern is whether financial policy helps or hinders smallholder access to finance by smallholders and other small or informal agri-food value chain actors. Policies set by central banks or Ministries of Finance can either foster development of services that cater to these actors, or they can set policies related to interest rates, loan terms, or collateral requirements that hinder the development of such services. Second, a major push among donors and policy makers has been to claim that employment generated by agrifood value chains can absorb a good portion of the population—youth and women, in particular—in search of employment (e.g., IFC, 2016; IFAD, 2019). A key question, then, is whether and under what circumstances expanded logistics or finance services leads to higher agri-food value chain employment.

Extending Services to Small Value Chain Actors

We first describe the conditions under which it is plausible that specific types of organized logistics services, or access to finance, could be cost-effectively disseminated to small agri-food value chain actors, including smallholder farmers. These services already exist in many LMICs, but they tend to cater towards larger farms and businesses. This means that the services exist already. However, key con-

straints to extending them to small agri-food value chain actors are informational problems and perceived challenges of cost-effectiveness. A further challenge is that there are clear economies of scale in transactions—in principle, it is easier to deal with one 100-hectare farm than 100 one-hectare farms.

This logic extends to any financial service that might help small actors make investments and manage risks, such as credit and insurance. Both types of services can be quite expensive to offer to small actors. In both cases, it can be costly to simply write contracts. Among farmers, a second issue hindering credit opportunities is that it can be costly for banks to ensure that they have collateral, and it can be difficult to monitor their effort to further minimize the risk of default. For insurance, it can be costly to measure whether farmers were really exposed to shock-triggering insurance payments. New technologies are helping address these issues. Banks and microfinance institutions have begun to issue credit through on-line applications, which can take place through mobile money services, and do not necessarily even require anything more than a feature phone (Suri et al. 2021). As noted above, electronic transaction histories—possibly generated through logistics services—can act as a substitute for loan collateral. Similarly, new satellite technologies are being used by the private sector to help improve crop insurance products (Ceballos, Kramer, and Robles 2019).

A second important concept relates to product value. Here, an important consideration is the difference between prices typically paid to farmers (or other small actors in the upstream portion of the value chain) versus prices paid at the wholesale level. Larger differences between these prices reflect transportation costs, risks to owning products that could spoil, and rents accruing to value chain actors between the farmgate and wholesalers or processors. If a specific value chain actor both has market power locally and can act upon it, then it will capture higher rents from trade in the value chain product. It is important to note that returns to agri-food value chain activities are based both on volume and the difference between revenues and costs. By increasing product quantity in the value chain, through improved credit, specific actors can make as much or more by increasing volume even if their rents on a per unit basis decline.

Modern logistics services can be made financially viable through product differentiation if there is value in a specific class of chains that can be captured through product tracing (to assure, for example, safe procedures are followed, or that organic products are not intermingled with other products). In this case, some market power can be advantageous, as actors with market power might find value in making investments themselves that spill over to other actors in the chain. Once the fixed costs of establishing modern logistics services for a specific value chain are invested, other chains may also crowd into using those services, as long as they have an actor willing to pay the marginal costs of entry.

Therefore, agri-food value chains that are more complex and diffuse may be less likely to engage in modern logistics services, as there is no actor or group of actors clearly willing to pay entry costs. Grain markets, for example, are often quite complex, markets for traders are often competitive, and end markets are geographically diffuse. Less organized grain markets are often present in countries without organized commodity markets (or thinly traded commodity markets). In these contexts—even if localized market power exists—it is unlikely that modern logistics services would be used. Further, it might be difficult in those markets to establish financial service demand, as it might be relatively difficult for service providers to understand risks on the provider side of the market.

If other conditions are met, new technologies can help reduce transaction costs between agri-food value chain actors, improving the viability of both organized logistics services and new types of financial services. Reduced transaction costs may make it profitable to work with small actors as the per-unit costs of providing them with services decreases. There are some necessary conditions, however.

Whereas mobile money platforms typically work on feature phones, most traceability applications require smartphones, as do more complex applications built on top of mobile money. New technologies requiring cell phones therefore require high levels of phone ownership as well as good cell phone service. Whereas if the value proposition was high enough firms could subsidize phone purchasing by farmers, cell phone coverage is determined by factors beyond the control of value chain businesses. Comfort and trust in the technology, combined with the education level needed to engage with such systems, can also be binding “environmental” constraints to widespread adoption (Anoop, Ajjan and Ashok 2015). Finally, from an inclusion perspective, it is helpful if households own more than one phone as otherwise the services may be dominated by male heads of households.

Organized Logistics, Finance, and Employment

Innovations in agri-food value chains do not just have potential to increase incomes among participants; they may also be an important source of employment. Recent research shows that an average of 73 percent of consumer food expenditures accrue to post-farm actors (Yi et al., 2021). The amount of value-added post-farm suggests substantial potential employment, possibly for more vulnerable groups. As a result, UN agencies, donor countries, policy makers, and practitioners all point to agri-food value chains as having the ability to absorb some of the demographic bulge taking place in LMICs, particularly in South Asia and Africa South of the Sahara (IFAD, 2019; FAO, 2020). This potential exists both among youth (e.g., Filmer and Fox, 2014; Dolislager et al., 2020) and women (Quisumbing et al., 2021).

Although general statements about the employment potential of agri-food value chains may sound promising, as discussed by Bellemare, Bloem, and Lim (2022) there is a considerable lack of evidence about in what specific segments of the agrifood value chain or for which commodities “good” jobs exist or will likely exist in the future. Moreover, while information about employment preferences for today’s youth is limited, the data that we do have often indicates that very few young people aspire to work in agriculture (Ross, 2019). And in some countries, women may only find access to low-skill, low-pay nodes of agrifood value chains (Kilic, Palacios-Lopez, and Goldstein, 2014).

It is an open question whether modern logistics services can drive employment increases in agri-food value chains. To the extent that reaching small actors with such services can add value and increase incomes, increases in employment are possible. In theory, the services themselves can provide new employment opportunities. The inherent mobile nature of many logistics operations, combined with the digital platforms used by modern services, mean that rural youth are well suited to benefit from opportunities as points of contact for those services. The digital components of these services can also provide new opportunities for women, by mitigating mobility constraints women often face (Aker et al. 2016; Garz et al. 2020). However, many modern logistics services are also focused on streamlining value chain activities, such as platforms that directly connect farmers to higher level buyers. Such platforms can help smallholder farmers, but could negatively affect total employment in the midstream that previously connected farmers to wholesalers. As further explored below, in value chains where those services are concentrated among poor or vulnerable populations, this is a tradeoff that must be considered.

Tradeoffs: Efficiency versus Equity

There are several potential tradeoffs that occur between outcomes as new logistics or financial technologies are adopted. Here, we focus on the tradeoff between efficiency and equity. While innovation in financial services and logistics can lead to improved market outcomes for both producers and consumers, these innovations can eliminate the need for some intermediary actors operating within agri-food value chains. For example, the introduction of internet kiosks in villages by a large soybean processor enabled resident farmers to easily observe wholesale prices of soybeans. Farmers benefited, as prices increased by up to three percent, but intermediary traders were eliminated from the value chain (Goyal, 2010). In contrast, though, Mitra et al. (2018) study the provision of price information via public boards and personal phone calls among potato producers, but it does not affect the prices they receive. They find wholesalers were not willing to buy directly from smallholders and were only willing to negotiate directly with traders. These competing examples—within the same country—illustrate that a complete view of the influence of agri-food value chain innovations on market structure must consider the potential losses to actors whose business activities might be undermined by innovation. These losses—and equity implications for vulnerable and marginalized populations—should be weighed against the potential benefits to producers and consumers associated with increased efficiency.

Innovative financial tools similarly have increased potential to build employment opportunities if they are well designed and targeted. If digital technologies can support financial services that are usable and affordable for small actors, these services can increase their working capital, drive new investments, and make financial connections more efficient. In theory, increased financial access can lead to increased income for small agri-food value chain actors, with the potential to promote entry into the sector for those who previously could not access capital. As with modern logistics, such services are well suited for growth among the youth population. Digital finance also holds promise for women, allowing for enhanced control of resources if she maintains funds in her own mobile account. However, the assumptions that such services can be affordable for users, profitable for financial institutions, easy to use, and trustworthy are strong, and these constraints must be solved for finance to reach its potential.

That all said, when modern logistics or new financial products become available to actors within a given agri-food value chain, it is important to understand potential tradeoffs. If a new, large trader can assert market power and reduce the number of middlemen, welfare might improve for farmers, but net welfare and employment might be reduced—and those reductions could occur among vulnerable groups. If, on the other hand, new products enable more firm entry and general economic growth, then welfare among value chain actors can be enhanced. For these reasons, it is important to conduct research alongside potential innovations in logistics or finance to understand their effect on employment and individual welfare.

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The initiative is currently undertaking research testing the effectiveness and scalability of market and value chain innovations in seven countries in Africa, Asia, and Latin America. In partnership with the ISEAL Alliance, the initiative has further launched the [Knowledge Platform for Inclusive and Sustainable Food Markets and Value Chains \(KISM\)](#) to help farmer organizations, food businesses, governments, and practitioners make better-informed investment and policy decisions on inclusive and sustainable food value chains. The Initiative's leadership thanks all funders for supporting this research through their contributions to the [CGIAR Trust Fund](#), and in particular also the Bill and Melinda Gates Foundation for designated funds received.

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