

Growing cotton to produce food: Unravelling interactions between value chains in southern Mali

Arouna Dissa^{1,2} | Jos Bijman³ | Maja Slingerland¹ |
Ousmane Mama Sanogo² | Ken E Giller¹ | Katrien Descheemaeker¹

¹Plant Production Systems, Wageningen University & Research, the Netherlands

²Equipe Système de Production et Gestion des Ressources Naturelles de Sikasso, Institut d'Economie Rurale (IER), Mali

³Business Management & Organisation Group, Wageningen University & Research, the Netherlands

Correspondence

Arouna Dissa, Plant Production Systems, Wageningen University & Research, PO Box 430 - 6700AK Wageningen, Netherlands.
Email: arouna.dissa@wur.nl

Abstract

Motivation: Most transaction cost economic frameworks, commonly used to examine and explain the co-ordination of agricultural transactions, use a linear approach for a single product transaction. This ignores the concurrence of multiple transactions by smallholder farmers in developing countries.

Purpose: This study aims to understand co-ordination among multiple product transactions by smallholder farmers and to identify ways to remove impediments to market participation. It develops an adapted transaction cost framework, considering contract types and forms of market participation as building blocks for co-ordination structures.

The framework was applied to explain co-ordination structures between smallholders and buyers of cotton and cereals in southern Mali. **Methods and approach:** To make the framework operational, we did the following: (1) selected transaction characteristics; (2) elaborated benchmarks to describe the intensity of transactions; (3) identified co-ordination structures; and (4) scored the intensity of transactions. Both quantitative and qualitative data were collected.

Findings: The majority of farmers grew cotton and sold it to a parastatal company, the sole buyer, that also supported the provision of inputs. Inputs were used to grow not only cotton, but also cereals. Most farmers sold cereals on spot markets to collectors and traders. Using different structures allowed smallholders to obtain inputs and services, to pursue different income sources over the year, and to balance flexibility and security.

Policy implications: Collective organizations of smallholder farmers should be supported to improve their financial and managerial capacities to allow them to co-ordinate better with buyers and input suppliers. Institutional innovations to better balance risks for smallholders and buyers deserve consideration. These innovations include crop insurance, long-term credit, and warehouse receipts.

KEYWORDS

co-ordination, farmer organizations, Mali, market participation, smallholders, transaction costs

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1 | INTRODUCTION

Empowering smallholder farmers for better market participation was a key foundation of the policies of market liberalization and reduced state intervention, initiated in many African countries since the 1980s (Dorward et al., 2005; Poulton et al., 2010). Access to secure and regular markets is particularly important in contexts where smallholders predominate in the production and market supply, such as in Mali (Coulibaly et al., 2015). The market participation of smallholder farmers is challenged by several factors (Jayne et al., 2010), including small farm size (Falconnier et al., 2015), seasonality of production, climate variability and related production risks (Traore et al., 2017), price volatility (Theriault et al., 2013), limited access to information (Egg et al., 2014) and a lack of proper market infrastructure (e.g., warehouses and roads). These challenges raise the costs of agricultural transactions between farmers and buyers. Transaction costs can be mitigated through a diversity of co-ordination structures, varying from loose co-ordination, in which sellers and buyers only use current market information for their exchange, to tight co-ordination, usually supported with institutional arrangements such as contracts and farmer organizations (Bijman & Wollni, 2009). Farmer organizations can lower transaction costs for both farmer and buyer, through realizing economies of scale, in particular for small-scale farms. Farmer organizations can substitute for other forms of farmer-buyer co-ordination (Vroegindewey et al., 2018). According to Transaction Cost Economics (TCE), the structure of co-ordination reconciles the interests of both parties to minimize costs while optimizing the utilization of productive assets (Williamson, 1979). Whereas TCE focuses on a single product transaction, smallholder farmers typically use the same assets to participate in the production and commercialization of multiple agricultural products (Leonardo et al., 2015). In southern Mali, farmers supply both cotton and cereals (Coulibaly et al., 2015) to very different markets by using a variety of co-ordination structures, each having different implications for farmers' access to inputs and services. In addition, a farmer's involvement in the supply of one product can influence the production and sale of other farm products. Such influences are ignored in transaction analysis based on a single product (Mugwagwa et al., 2020; Vroegindewey et al., 2018). Moreover, studies using the TCE framework mostly start from the perspective of the buyer sourcing a product (Key & Runsten, 1999; Sartorius & Kirsten, 2007) and mostly ignore the farmers' perspective. The simultaneous involvement in transactions of multiple products is important in explaining farmers' preference for particular co-ordination structures. Farmers may choose a particular co-ordination structure because it provides them with access to farm inputs and services. The objective of this study is to understand the concurrent co-ordination of transactions of several agricultural products by smallholder farmers in southern Mali in order to identify relevant policies to remove market participation impediments.

We propose a framework to analyse the co-ordination structures used by smallholder farmers who are simultaneously involved in the production and sale of cotton and cereals. We then apply the framework to explain how the observed co-ordination structures contribute to minimizing transaction costs. Our research was guided by two research questions. First, which structures of co-ordination between farmers and buyers exist in the markets of cotton and cereals, and what explains their occurrence? Second, through which forms of market participation do farmers ensure access to inputs and services in producing and selling cotton and cereals?

2 | MATERIALS AND METHODS

2.1 | Conceptual framework

Transactions bring together two parties with convergent needs to exchange goods and services. Transaction costs may be tangible (transport or storage) or intangible (time and effort), ex-ante (search and negotiation cost) or ex-post (monitoring and enforcement cost), and have to be covered by one or both of the parties (Rindfleisch & Heide, 1997). The parties can use diverse forms of co-ordination (Peterson et al., 2001) to deal

with (potential) transaction costs. Co-ordination is defined as the alignment and adjustment of the actions of the parties (Gulati et al., 2012). Co-ordination of agricultural transactions takes place at multiple levels, including production, sales, and processing. Co-ordination can rely on different contract types (Kirsten & Sartorius, 2002), including spot market, market contract, resource-providing contract, alliance, and vertical integration (Table 1). Some contract types are supported with institutional forms of farmers' market participation (Kirsten & Sartorius, 2002; Sporleder, 1992), which range from individual sales, over collective organizations such as the bargaining association, the marketing association, and the advanced co-operative, to vertical integration of production and marketing (Chaddad, 2012). Producers often prefer individual market participation because of the freedom to make individual sales decisions. However, in a situation of limited bargaining power, farmers set up a bargaining association to sell their products collectively. Beyond the objective of joint sales, farmers have established associations to access inputs and services. Further, farmers may invest in an advanced co-operative to obtain the benefits of joint processing. Farmer organizations may be conceptualized as intermediaries between farmers and buyers (thus co-ordinating the sales process), but they can also be buyers themselves. In the latter case, the organization decides on the quantity and quality requirements for deliveries by the members. The more sophisticated the processing and marketing activities of the farmer organization, the more it behaves like a final buyer.

TABLE 1 Summary of characteristics of the contract types to co-ordinate agricultural transactions

| Contract type | Characteristics of the contract type | Co-ordination level | Reasons for the use of contract type |
|-----------------------------|--|------------------------|---|
| Spot market | The "invisible hand" of the market guides the decisions of the parties to transact. | Very loose | Co-ordinate transactions of small volume in markets with many competitors. Very low transaction costs for both parties. |
| Market contract | Transaction is agreed before delivery. Parties share information regarding quality, delivery time, and pricing. | Weak | Buyers seeking small-to-medium volume of products with good quality prefer the market contract to minimize cost (of quality improvement). Sellers can secure a good price for their products, particularly in uncertain situations. |
| Resource-providing contract | Transaction is agreed before delivery. Information sharing, joint planning, and monitoring. Buyer provides resources in support of the production. | Strong | Buyers use this contract to secure a consistent supply of large volume and good quality products, particularly when substitute products are absent and/or buyers have made heavy investment in assets. Producers do not have to buy the resources themselves, and receive technical advice linked to the resources. |
| Alliance | Long-term partnerships; repetitive transactions; information sharing, joint planning, and monitoring. | Very strong | When (production) activities of both parties are strongly interdependent, parties seek a long-term guarantee from their partner, for instance by joint equity investment. |
| Vertical integration | Tight co-ordination inside a single farm (or firm) of all aspects of the transaction. | Internal co-ordination | Faced with very high intensity of transaction characteristics to implement transaction as separate partners, farmers and buyers vertically integrate in a single large firm (or farm). |

Source: Adapted from Vroegindewey et al. (2018); Sartorius and Kirsten (2007).

Transaction cost frameworks have been used (Sartorius & Kirsten, 2007; Vroegindewey et al., 2018) to portray how the intensity of transaction characteristics affects the choice of contract type (Table 1). Transaction costs increase with the intensity level. The key transaction characteristics include asset specificity, frequency, and uncertainty (Williamson, 1979). Asset specificity refers to investments done specifically for the (repeated) transaction, making the investor dependent on the transaction partner. Frequency is about the repetitiveness of the transaction. Uncertainty may be endogenous, such as failure to comply with transaction agreements, or exogenous, such as price volatility and changes in public policies.

Building on previous studies, we develop an adapted framework that considers both the contract types and the forms of market participation as building blocks of co-ordination structures. In particular, our framework incorporates the perspectives of both smallholder farmer and buyer on the intensity level of the transaction characteristics. Operationalization of the framework followed four steps.

The first step was the assessment of the relevant transaction characteristics that influence the use of different contract types in the Malian context (Vroegindewey et al., 2018). Transaction frequency was assessed by the recurrence of sales or purchases per year. Two aspects of asset specificity were considered, namely investments in productive assets and the degree of dependence between transaction partners. The latter is inversely related to the flexibility to find alternative market opportunities and is determined by the extent of market competition (Martins et al., 2017). Finally, uncertainty was evaluated by the number of sources of price and production risk, such as sudden change in production support policies or market conditions, climate variability, or crop failure.

In the second step, we elaborated a benchmark table (Table A1 in the Appendix) containing five ranges of values corresponding to the different intensity levels, based on the perspective of each transaction partner. Transactions involving high recurrence, high investment in productive assets, high dependence between parties, and high risk would represent high transaction costs. The determinants of the characteristics were derived from theoretical and empirical literature (Sartorius & Kirsten, 2007; Vroegindewey et al., 2018), whereas the ranges were derived from local information sources, (grey) literature (CMDT-Filiale-Nord-Est, 2017:2019; Diarra et al., 2011; Kaminski et al., 2013), and interviews with farmers, buyers, and industry experts.

In the third step, we identified the co-ordination structures between smallholder farmers and the local buyers, and collected information on the transaction characteristics, as perceived by each partner individually, and contract types. In the fourth step, the information gathered was compared to the information contained in the benchmark tables, on which basis a score was assigned. The scores ranged from 1 to 5, corresponding to an increasing intensity level of the transaction characteristics.

2.2 | Data collection strategies

We used in-depth investigations based on a case study approach (Eisenhardt & Graebner, 2007; Zainal, 2007) to have a thorough understanding of co-ordination structures being used in transactions between smallholder farmers and buyers of cotton and cereals. The data were collected in six villages of the old cotton basin of Koutiala, southern Mali, where cotton and cereals are produced and supplied by smallholder farmers. The villages were selected by an NGO project partner that is well established in the area, based on the presence of farmer organizations with different levels of functioning. The longitudinal approach of data collection, from 2017 to 2020 (Figure 1), was aimed to capture changes that affected the production and commercialization, leading to a superior understanding compared to a cross-sectional approach (Eisenhardt & Graebner, 2007). The data collection strategies included both qualitative and quantitative methods. Qualitative methods were adopted to gain insights into complex institutional and social processes shaping the use of different co-ordination structures (Boeije, 2009). These methods included focus group discussions (FGDs) with farmers, semi-structured interviews with key informants, observations, and triangulation workshops. The qualitative information was completed with

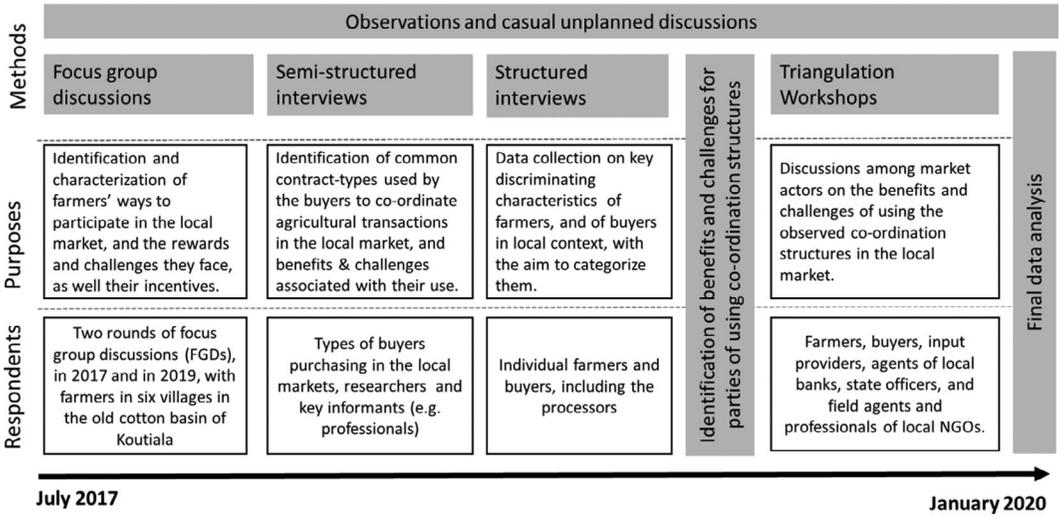


FIGURE 1 Data collection methods

quantitative data from farmers and buyers, to assess the transaction characteristics for each party. The investigations were conducted for each value chain separately, but, in talking with farmers, cotton and cereals transactions were discussed jointly.

The data collection started in July 2017 with a first round of FGDs with groups of 12 to 20 farmers, to investigate the forms of market participation and the challenges encountered. A second round of FGDs was implemented in 2019 and included two to five leaders of farmer organizations. Discussion focused on the role of the organizations and the challenges encountered in facilitating access to inputs and output markets. In total, 25 FGDs were carried out over the three years in six villages. The duration of the FGDs varied between 45 to 120 minutes.

Interview guides were elaborated using manuals for value chain analysis (Riisgaard et al., 2010; UNIDO, 2011), but adapted to the local context. Semi-structured key informant interviews were conducted throughout the three years. In total, more than 30 interviews were realized with the village-level collectors, wholesalers, and processors that were mentioned by farmers in the FGDs as their transaction partners. Questions revolved around key activities, contract types, and encountered challenges. In addition, more than 30 professionals and experts from development organizations, NGOs, and government departments were interviewed.

Questionnaires were prepared for collecting quantitative data from farmers and buyers on the co-ordination of transactions. Findings from the FGDs and key informant interviews were used to elaborate first drafts of questionnaires, which were then tested and refined. The structured interviews with farmers were spread over 2018 and 2019, to capture seasonal trends in production and commercialization. A total of 118 farmers were surveyed to collect data on production equipment, annual volume of production, sales frequency, amounts sold, inputs and services used, and motives to use specific co-ordination structures. Both cotton and non-cotton farmers were selected in the villages based on their availability and willingness to participate. We purposively surveyed farms of different levels of resource endowment (Falconnier et al., 2015) to account for heterogeneity in market participation. Buyers were asked about their equipment, annual trade volumes, securing of supplies, and to what extent they sourced directly from farmers using specific contract types. For cereals, both wholesalers and collectors were surveyed. For cotton, also a local officer of the cotton company was interviewed.

Key findings from the FGDs and semi-structured interviews were presented and discussed in triangulation workshops, to strengthen both internal and construct validity (Gibbert et al., 2008). The key findings were first

presented in plenary sessions, then the participants were divided into two sub-groups to discuss each value chain (groups comprising farmers, buyers, and professionals). Next, the conclusions of each sub-group discussion were presented and discussed in a plenary session.

A first triangulation workshop, conducted in November 2018, discussed key findings from the first round of FGDs and key informant interviews; the main topics discussed were the challenges of market participation and farmers' access to inputs and credit. The workshop had 30 participants, including 20 farmers, four cereal buyers, three providers of inputs, one officer of an agricultural credit institution, and one officer of the cotton company. The second workshop, organized in January 2020, discussed information on farmer organizations for cotton and cereals, collected from the second round of FGDs and key informant interviews with leaders of these organizations. The discussions revolved around the activities of the organizations and the challenges in functioning properly. This workshop had 47 participants, including 24 farmer-leaders, buyers, and professionals.

Furthermore, observations, casual discussions, and participant observations improved our understanding of farmers' preferences for different co-ordination structures. The observations and casual discussions were possible from the immersion of the lead author in the study area, over the three years. Similarly, the participant observations were possible through joining third party workshops bringing together farmers, buyers, providers of inputs and credits, and professionals working closely with farmers.

2.3 | Study area

The old cotton basin of Koutiala is the second largest cotton production area in Mali in terms of land and volume. In this area, agricultural production is mainly done by the 65,000 smallholder farmers. Farmers produce and sell all the cotton to the local office of *Compagnie Malienne pour le Développement des Textiles (CMDT)*, a parastatal trading company. Cotton plays an important role in the livelihoods of the farmers. The reports of the local office of CMDT (CMDT-Filial Nord-Est 2017, 2018) indicate that farmers allocate about 30% of their land to cotton production, varying between 1 ha to 40 ha per farm. From 2012 to 2018, farmers annually supplied an average of 180,000 tonnes of cotton to CMDT.

Next to cotton, farmers allocate about 60% of their land to cereal cultivation for home consumption and surplus selling in the local market. CMDT reports indicated that this region is food self-sufficient (based on 250 kg cereals per capita per year) and is able to realize a marketable surplus varying between 200,000 and 400,000 tonnes of cereals per year, in the period 2012 to 2018. As such, the area is often qualified as the cereal basket of Mali. The cereals are sold to different types of buyers in the local market, including collectors, traders, and institutional buyers, such as the Malian Office of Grains and the World Food Programme.

3 | RESULTS

3.1 | Production and marketing by smallholders

About 96% of all farmers interviewed ($n = 118$) produced cotton, and all cotton was brought to market. All farmers produced cereals, but only 71% sold cereals in the market, while the other 29% used all cereals for home consumption (see Table A.2 in the Appendix).

Every year in April, the cotton price is agreed between the cotton company and the farmers represented by the national union of cotton producers, and it is fixed for the whole year. However, it varies across years (Figure 2). Cereal prices follow the seasonal availability of stocks, being low after the harvest (October–January), when new grains enter the market, and higher between June and September when stocks become depleted. However, it may happen that cereal prices remain low the whole year, such as in 2019, indicating an abundant supply.

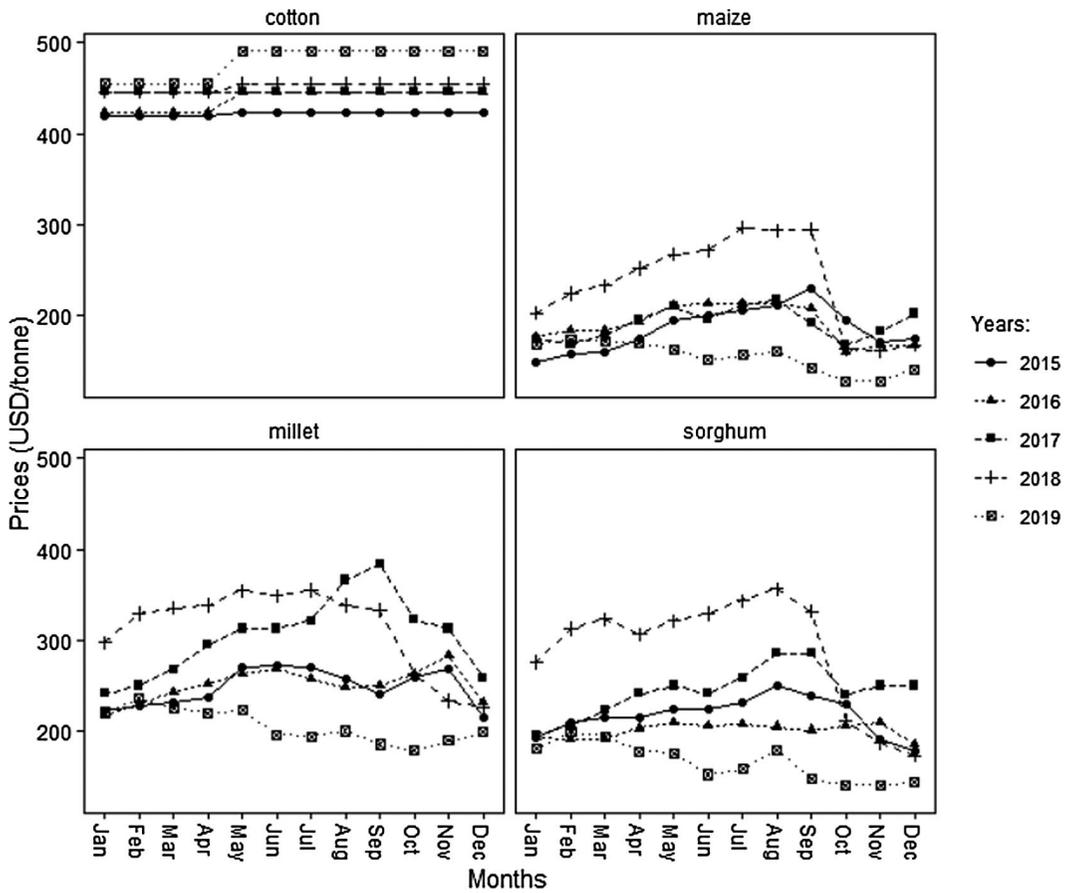


FIGURE 2 Intra- and inter-seasonal variation of cotton and cereals prices (2015–2019) in the Koutiala district. Source: Cereal prices from the “Observatoire du Marché Agricole” (OMA) and cotton price from the CMDT (data available on request)

3.2 | Co-ordination

3.2.1 | Co-ordination structures: Contract types and forms of market participation

The co-ordination structures encountered in the study area varied between and within value chains (Figure 3). All cotton produced was sold collectively to the CMDT through marketing associations (grouping 25 to 100 farmers) on the basis of resource-providing contracts. By contrast, cereals were sold using one or all of three forms of participation and two types of contracts (Figure 3). Individual sales (69% of farmers and 10% of the total production) were mainly to collectors based on spot market co-ordination, while collective sales were done by two types of associations based on market contracts with cereal traders. About 47% of the farmers sold roughly 1% of the total production via a bargaining association (bringing together five to 20 people), whose only role was to aggregate a large volume of cereals to obtain a better price.

In addition, 20% of farmers sold 2% of total production via marketing associations (joined by 15 to 30 suppliers), in which farmers also collaborate to jointly purchase inputs and share warehouses. Both bargaining and marketing associations sell to cereal wholesalers. Farmers selling collectively were mostly those with a large surplus, and thus in need of storage facilities until the period of high prices. Despite the limited sales via the associations,

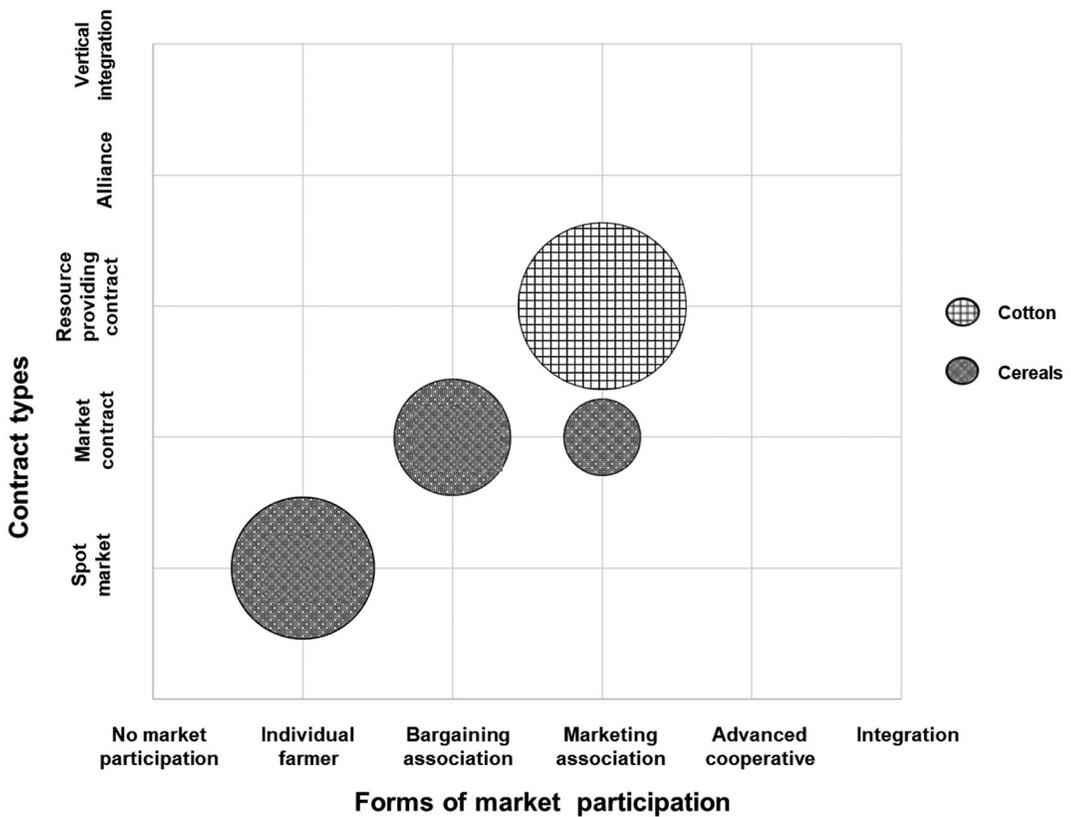


FIGURE 3 Different structures of co-ordination to sell cotton and cereals. (Note: the size of the bubble reflects the percentage of farmers using the specific structure of co-ordination)

farmers showed a relatively strong interest in participating in these organizations in order to have access to the knowledge, technology, and infrastructure provided by development initiatives.

3.2.2 | Co-ordination structures providing access to inputs and services

The resource-providing contracts for cotton allowed farmers to seasonally obtain, on credit, mineral fertilizer (used for both cotton and cereals), pesticides, and small equipment, such as spraying tools. The inputs were allocated by the cotton marketing associations, based on joint liability among farmers to pay back the loans. The credit payment was facilitated by a local bank, which was involved in all the transactions between the CMDT and the cotton marketing associations. This arrangement protected both parties from payment default. Furthermore, the cotton co-ordination was supported by an independent third party, called “Centre de Gestion Rurale,” charged with doing the accounting for the cotton marketing associations.

Farmers relied heavily on spot markets for cereal sales. Because there is no link between sales in the spot market and access to inputs and services, many farmers face difficulties obtaining inputs at the right time, such as the mineral fertilizer needed for cereals between June and August. In addition, small volume sales on the spot market constrain the bargaining power of farmers for obtaining a good price.

The cereal bargaining and marketing associations were created to overcome limited bargaining power and to support farmers' access to inputs. The associations aggregated and sold quality products against the highest possible price, based on market contracts. In doing so, farmers could obtain a margin over the spot market

price, ranging from 10% to 25%, and they could often benefit from services provided by the traders, such as transport of the products. Nevertheless, the cereal marketing associations were not regularly used by farmers for accessing inputs (see Table A3 in the Appendix), because of other options available, including the cotton contracts. The collective sales of cereals were associated with higher dependence compared to individual market participation, because farmers would have to co-ordinate their sales with fellow farmers. Next to joint sales, the cereal marketing associations pre-financed farmers' access to inputs against in-kind repayment after the harvest. However, payment defaults after receiving inputs were frequent, which affected the regular provision of inputs and services. Another challenge for the associations was the unexpected lower cereal prices (as happened in 2019), which can lead to a loss of income for the marketing associations, thus affecting the future provision of inputs and services.

3.2.3 | Complementarity between the value chains in supporting farmer livelihoods

Farmers typically produced cotton only for income and cereals for both food and income. However, farmers also engaged in cotton and cereal markets to meet specific farming and livelihood objectives. Indeed, farmers accessed mineral fertilizer in a timely manner through their participation in the cotton marketing association. This allowed them to avoid selling cereals at a time when their cereal stocks were dwindling. Almost 65% of the cotton credit was allocated to inputs for cotton and 35% to inputs for cereals. In addition, knowing the cotton price ahead of the cropping season was important as it allowed farmers to plan their activities, including the use of seasonal labour and inputs. Moreover, the income from cotton becomes available when the prices of cereals are low (January–April, Figure 2). This allowed farmers with large surplus of cereals to delay their sales until a better price could be obtained.

In contrast to the relatively large and one-off income from cotton, cash from cereal sales was mobilized any time throughout the year to support various expenditures, including the repayment of cotton debt in case of poor cotton production, and the purchase of inputs (Figure 4). Seventy percent of the cereal sales occurred between February and May and supported expenses not related to cereal production. Furthermore, 20% of sales took place between October and January, when the cash was used to pay for (post-) harvest labour and cotton debt. These findings illustrate that production and commercialization of cotton and cereals are interdependent; inputs needed for cereal production are heavily supported by cotton credit, while cotton labour and debt are often paid from cereal sales.

3.3 | Intensity of transaction characteristics

The cotton and cereal transactions exhibited different co-ordination structures and varying degrees of intensity of transaction characteristics for farmers and buyers (Tables 2 and 3). We describe these differences using scores that reflect where to situate the farmers and buyers on a continuum from low (1) to high (5) intensity of transaction characteristics.

3.3.1 | Intensity of transaction characteristics in the cotton value chain

The cotton transactions took place only once per year (Table 2), based on resource-providing contracts (Figure 3) between the cotton company and smallholders organized in marketing associations at village level.

With respect to investment in productive assets, each cotton farmer owns equipment such as ploughs and donkey carts that are used for many other cropping activities. In addition, farmers of the same marketing association

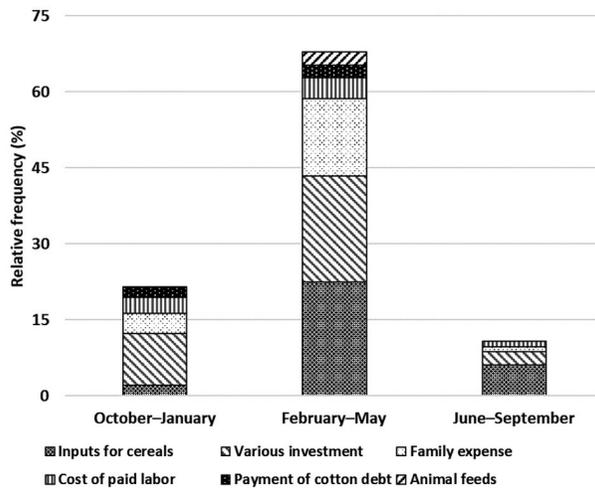


FIGURE 4 Relative frequency of cereal sales and the related reasons during the harvesting period (Oct–Jan), the dry season (Feb–May) and the growing season (Jun–Sep) ($n = 118$)

TABLE 2 Intensity of cotton transaction characteristics—with scores ranging from 1 (low intensity) to 5 (high intensity)

| | Collective sales of cotton under resource-providing contracts | |
|---|---|--|
| | Farmers (COMA) | Buyer (CMDT) |
| Recurrence of sales or purchase | Once a year 1 | Once a year 1 |
| Long-term financial investment in productive assets | Individual productive assets and shared equipment (warehouse) that have many alternative uses 2 | Complex modern processing /logistics, high-skilled staff with no alternative occupation 5 |
| Dependence on the transaction partner; market structure | High dependence on one buyer; strongly regulated market 5 | High dependence on many village-level marketing organizations, united in a national union; strongly regulated market 5 |
| Sources of uncertainty | <ul style="list-style-type: none"> Climate variability Human or animal diseases High debt burden due to regular crop failure 4 | <ul style="list-style-type: none"> Climate variability Payment of high price for a poor-quality cotton 3 |

Note: COMA: cotton marketing association; CMDT: cotton company. A higher score corresponds to higher transaction costs (refer to the benchmarks in Table A1 in the Appendix).

share productive assets, including warehouses, weighing scales, and a motorbike for transport. Consequently, as Table 2 shows, the intensity score for investment is low (score 2), which is in sharp contrast to score 5 for the major capital investment by the CMDT. This unique buyer owns, in the old cotton basin of Koutiala, five ginning factories, a laboratory for cotton quality analysis, and vehicles, and employs more than 200 permanent employees, with limited alternative use and occupations.

TABLE 3 Intensity of cereal transaction characteristics from the perspectives of farmers and buyer—with scores ranging from 1 (low intensity) to 5 (high intensity)

| | Individual sales on spot markets | | Collective sales under market contracts | | Collective sales under market contracts | |
|---|--|---|--|---|--|---|
| | Individual farmer | Buyer (collector) | Farmer (CBA) | Buyer (trader) | Farmer (CMA) | Buyer (trader) |
| Recurrence of sales or purchases | 2–5 times per year 2 | Weekly 4 | Once a year 1 | Weekly 4 | Once a year 1 | Weekly 4 |
| Long-term financial investment in productive assets | Manual or artisanal equipment that has alternative uses 1 | Traditional storage 1 | Manual or artisanal equipment that has alternative uses 1 | Artisanal warehouses that have alternative uses 2 | Small mechanized equipment that has alternative uses 2 | Modern warehouses and transport logistics that have alternative uses 3 |
| Dependence on the transaction partner; market structure | Small amount can be sold to various buyers 1 | Sourcing from many sellers with small volume 1 | Small-medium aggregated volume to sell to traders who are many 2 | Sourcing of small-medium volume within trading network 2 | Medium aggregated volume to sell to traders who are many 2 | Sourcing of medium volume within trading network 2 |
| Sources of uncertainty | <ul style="list-style-type: none"> Price volatility Human or animal diseases Climate variability Frequent changes in production support policies | <ul style="list-style-type: none"> Price volatility Farmers suspend sales | <ul style="list-style-type: none"> Price volatility Human or animal diseases Climate variability Frequent changes in production support policies | <ul style="list-style-type: none"> Price volatility Farmers suspend sales | <ul style="list-style-type: none"> Price volatility Human or animal diseases Climate variability Frequent changes in production support policies | <ul style="list-style-type: none"> Price volatility Farmers suspend sales |
| | 5 | 3 | 5 | 3 | 5 | 3 |

Note: CBA: cereal bargaining associations; CMA: cereal marketing association; traders include the cereal semi-wholesalers and cereal wholesalers. A higher score corresponds to higher transaction costs (refer to the benchmarks in Table A1 in the Appendix)

The cotton transactions are characterized by high dependence between the seller and the sole buyer, also because of a strongly regulated market. Farmers are organized in village-level marketing associations which are then organized in a national union. The union negotiates the terms of exchange on behalf of all suppliers. The cotton company does not have alternative suppliers other than the many marketing associations, from whom it needs to secure a large volume of cotton to use its productive assets efficiently. Therefore, the maximum score was assigned to the dependence between transaction partners.

Cotton production is subject to environmental uncertainties, in particular climate variability. It is common that a late start of the rainy season and/or prolonged rain during the harvest period negatively influences the volume and quality of production. This risk is felt equally by the farmers and the CMDT. However, farmers may face risks related to human or animal diseases (Huet et al., 2020), which can jeopardize timely land preparation and crop management operations. In addition, the cotton marketing associations are exposed to indebtedness due to crop failure among the members. For the buyer, there is the risk of poor-quality cotton while paying the price for a high quality grade. Overall, the exposure to uncertainty was deemed greater for the farmers (score 4) than for the buyer (score 3).

To summarize, although the level of investment by the buyer in productive assets is larger compared to the investment by the farmers, the parties succeeded to develop and use a co-ordination structure that protects their mutual dependence.

3.3.2 | Intensity of transaction characteristics in the cereal value chain

Individual farmers sell cereals on the spot market three to five times per year in varying amounts, ranging from 0.1 to 2 tonnes per transaction. These sales are to cereal collectors who purchased on a weekly basis from many smallholders. As Table 3 shows, the frequency of sales by farmers was assigned a score of 2, while the weekly purchases by collectors received a score 4. Farmers' collective sales through associations are usually once a year (score 1) with traders during one specific period of high prices (from May to July). Like the collectors, the traders also purchase on a weekly basis (score 4). Traders are primarily supplied by their network of collectors and only marginally by farmers' associations. In addition, selling–buying transactions among the traders are common, so as to quickly purchase large amounts.

The same equipment used to produce cotton is deployed for cultivating cereals. Cereal farmers who sell on an individual basis or through a bargaining association do not share any equipment with fellow farmers, so their investment risk is low (score 1, Table 3). However, marketing associations use common equipment, such as warehouses and threshers, which is reflected in the slightly higher score of 2. The productive assets of the two buyer categories are different. Collectors invested little (score 1), because they rented public places and weighing scales, and hired transport services. The traders invested more (score 2), as they usually own warehouses, and some possess large modern storage spaces (capacity of 2000 tonnes or more) and transport means (one or more trucks). The equipment is mainly dedicated to trade, but can have alternative uses, such as renting out.

Cereal markets are highly competitive for both the sellers and buyers. Over the year, smallholder farmers sell small amounts per transaction on individual basis to different buyers. Consequently, the balance of supply and demand determines the market price. In this market, a farmer has ample choice to select a buyer, and a collector is not dependent on a particular supplier, in sourcing between 1 and 50 tonnes each week. Accordingly, score 1 was assigned to the dependence between farmers and collectors on the spot market (Table 3).

The collective sales of cereals are associated with less freedom for both farmers and traders (who are far fewer in number than the collectors). In addition, the collective sales by farmers are associated with a loss of freedom to choose a preferred buyer from whom a fair price can be obtained. Indeed, more than 70% of the farmers said that they preferred to sell on the spot market with their own preferred buyer because of access to accurate price information. Moreover, the collective sales require farmers to align and synchronize their sales decisions at an agreed

moment, preferably once or twice per year in the high-price period. However, the traders mentioned to purchase amounts varying between 50 to 200 tonnes each week from collectors or other traders. Therefore, the operating mode of traders does not match with the collective sales of small-medium volume (from three to 30 tonnes) by farmers that occur once or twice per year. Indeed, all traders with whom we spoke emphasized that direct supply from associations of farmers is not common in their business and represents a very small share (less than 5%) of their annual traded volume. Therefore, a score of 2 was assigned to the dependence between the associations and traders when using market contracts.

The permanent spot market and the non-perishable nature of cereals allow the intra-seasonal variation of prices (Figure 2). Price volatility is experienced equally by farmers and buyers (Table 3). However, the parties also face other types of uncertainties. Irrespective of the form of market participation, farmers are exposed to frequent changes in cereal production support policies. These include sudden changes in fertilizer subsidies, fertilizer distribution procedures (2018 and 2019), or fertilizer stocks (2019), all leading to an unreliable fertilizer supply. In addition, land preparation and crop management were often compromised by human or animal diseases (Huet et al., 2020), such as the outbreak of bovine foot-and-mouth disease in 2018. On the other hand, buyers are exposed to a high risk of non-compliance of farmers even under a contract with an association (score 3).

In summary, the organization of cereal transactions poses difficulties of co-ordination for the traders to directly source the volume they need. Nevertheless, farmers have permanent market access to sell cereals to collectors. Farmers suffer from higher exposure to uncertainties than buyers even when selling through the cereal associations.

4 | DISCUSSION

4.1 | Framework to analyse co-ordination structures

The framework we developed combines contract types and forms of market participation. We applied the framework to assess the co-ordination structures of cotton and cereals, based on scoring of transaction characteristics from the perspective of both farmers and buyers. This provided insights into the complex institutional and social functioning of local value chains, informing policy-making to improve the market participation of smallholder farmers (section 4.3).

Individual farmers were involved in different co-ordination structures depending on the product, but even for one product they used different structures (Figure 3). This helped them to spread risk and to maximize access to services and inputs. By revealing these patterns, our framework goes beyond existing frameworks based on transaction cost theory (Martins et al., 2017; Sartorius & Kirsten, 2007; Vroegindewey et al., 2018) which use a linear approach to assess transactions of one product and from the perspective of one party.

Our research builds on but is different from the study by Vroegindewey et al. (2018), which was also conducted in Mali. These authors developed a transaction cost framework that addressed co-ordination in cereal value chains from the angle of linking smallholder farmers to high-value markets via farmer organizations. Our approach, however, looks at the overall market participation of farmers—individual and through farmers organizations—for multiple products to understand the use of different co-ordination structures. Our approach follows Leonardo et al. (2015) in capturing interactions among value chains resulting from smallholder farmers' involvement in the production and commercialization of multiple products.

Scoring the intensity of transaction characteristics revealed strengths and bottlenecks in the observed co-ordination structures. Cotton transactions were carried out through a structure that allows a single buyer to source cotton from thousands of smallholder farmers through marketing associations at village level. These associations were organized into a national union that negotiates the terms of exchange with the cotton company. The symmetric dependence between farmers and buyer indicated that the co-ordination structure enabled a fair

balance of transaction costs (Roy, 2010). For cereals, on the other hand, traders purchased medium volumes on a weekly basis within the trading network, while collective sales by farmers of small-to-medium volumes happen only once a year. This discrepancy explained the lack of incentives for traders to source directly from farmers, as they can efficiently source from their network of collectors (Mangnus & Vellema, 2019).

Our results corroborate earlier findings on contract farming that indicated that the nature of the product and the extent of market competition strongly influence the choice of contract types (Kirsten & Sartorius, 2002; Minot, 2018; Mugwagwa et al., 2020). Indeed, the use of resource-providing contracts for cotton was explained by the lack of competition and the need for co-ordination between buyer and producers (Table 1). In contrast, cereals are staple crops produced primarily for home consumption and have many substitutes, favouring the use of spot market co-ordination. The highly competitive cereals' market, with networks and partnerships between buyers involved in frequent transactions, was always accessible to farmers (Diarra et al., 2011; Mangnus & Vellema, 2019). Under such conditions it is not surprising that cereals were mostly traded on spot markets. Therefore, product type and market functioning matter when identifying policies for improving the bargaining position of smallholders in value chains.

Furthermore, in line with TCE predictions, we found that transactions involving low costs of safeguarding, such as for cereals, were carried out on spot markets by individual farmers. However, with higher costs and a pressing need for co-ordination, such as for cotton, the parties favoured long-term partnerships (Rindfleisch & Heide, 1997; Williamson, 1979).

Alternative co-ordination structures in selling cereals provided little incentives for contracting and for provisioning of inputs and services, because of the risk of side-selling or side-use (Kirsten & Sartorius, 2002; Poulton et al., 2010). The limited use of the cereal marketing associations can be explained by their failure to co-ordinate the provision of inputs and services. In contrast, the use of the cotton marketing associations by farmers was explained by the fact that these were the only possible channel for cotton transactions. Moreover, through this participation farmers were able to access inputs and services.

Previous research found that the effectiveness of farmer organizations depends on whether they are supported by the buyers (Hellin et al., 2009; Markelova et al., 2009). In addition, cereal farmers were reluctant to participate in collective sales as it was associated with limited flexibility in selling products. The potential price benefit from collective sales later in the season did not outweigh the advantage of satisfying urgent cash needs by immediate sales, even at lower prices. These results align with Bonus (1986), who pointed out that farmers' preference for different forms of market participation is shaped by two conflicting drivers, making individual decisions and the need for collective action.

4.2 | Farmers' participation in multiple markets

The co-ordination of transactions by farmers was affected by their participation in multiple markets (Bolwig et al., 2010; Leonardo et al., 2015). Our study suggests that farmers participated in both cotton and cereal value chains for a series of reasons: (1) to diversify sources and timing of income; (2) to secure access to credit and agro-chemicals through cotton transactions; and (3) to strike a balance between the security provided by cotton sales and the flexibility in cereal sales. These results fill a knowledge gap, indicated by Vroegindewey et al. (2018), about the interaction between cotton and cereal value chains.

Cotton is the primary source of income in southern Mali, but the unpredictability of cotton production and commercialization seriously affects farmers' livelihoods (Huet et al., 2020; Traore et al., 2013). Diversification in production and commercialization (McCord et al., 2015) helps farmers to buffer risk, such as the cotton price shocks during the 2000s (Falconnier et al., 2015; Laris et al., 2015). Indeed, the sales of the two products were complementary in supporting the farming households' need for cash at different times and for different expenditures, including health care, school fees, and hired labour. Producing cotton allowed farmers to obtain inputs for cereals on credit during the cropping season, thereby mitigating finance constraints. Furthermore, farmers apply a

three-year rotation system based on cotton-maize-millet/sorghum with application of manure once in the cotton field and subsequent crops benefiting from the leftover nutrients.

Farmers' participation in the two value chains also implied trade-offs in the allocation of limited resources, such as labour (Tittonell et al., 2007). Farmers recognized that their involvement in cotton production compelled them to produce enough cotton to repay the cotton credit. Also, they primarily allocated their labour to cotton fields, because the timely implementation of field operations is critical to realizing good cotton yields. This prioritization results in trade-offs because of strong competition for labour between crops, in particular in the harvest period.

4.3 | Improving market access

Farmers gained access to cereal fertilizer from their involvement in cotton transactions. However, many farmers and key informants indicated that the amounts received were insufficient. In addition, farmers who do not grow cotton required alternatives to finance their inputs for cereals. Post-harvest facilities, threshers, and storage places were only provided by cereal marketing associations, which had limited capacity to mobilize funds.

These issues could be solved if the cotton marketing associations were to facilitate farmers' access to all required inputs and services for cereals and also implement collective sales of cereals (Dia & Traore, 2011). Accordingly, improved market participation of cereal farmers could rely on institutional innovations, such as a warehouse receipt system (Coulter & Onumah, 2002) that facilitates access to credit against future reimbursement. The national law on the warehouse receipt system was promulgated in 2018 to support farmers' access to credit in periods of low cereal prices against a deposit of cereals as collateral. In addition, the farmer organizations benefited from policy support, such as the 2013 law on co-operatives (Uniform Act on Co-operatives of OHADA), which recognized these organizations as business entities. However, the implementation of the warehouse receipt system suffered from the risk of year-round low prices, as in 2019 (Figure 2). This risk could be prevented, for instance, through an insurance (Byerlee et al., 2006). Alternatively, marketing associations could receive policy support for building financial reserves or accessing long-term credit as well as larger storage capacity to allow sales up to two years after the harvest.

5 | CONCLUSION

Smallholder farmers' involvement in agricultural transactions has previously been studied using transaction cost frameworks based on a single product approach. However, this approach overlooks farmers' involvement in multiple value chains that differ in transaction costs and complement each other in supporting farming activities. We developed and applied an adapted framework to study the simultaneous involvement in transactions of multiple agricultural products, which deepened our understanding of the incentives of transaction partners to use particular co-ordination structures. By considering the perspectives of both farmers and buyers we gained insights into the complex functioning of local value chains, which allows identifying policies for improving the functioning of value chains and strengthening the bargaining power of smallholder farmers. In addition, the use of the framework revealed that farmers relied on various co-ordination structures to meet different farming and livelihood objectives, such as to secure access to inputs, to balance flexibility and security of sales, and to benefit from specific timing of sales. By assessing agricultural transactions in the local context, this study also generated insights into how to overcome obstacles of smallholder farmers' access to inputs, services, and credit.

The framework can be used to study co-ordination among value chains in contexts where cotton is grown as the main cash crop, with other crops for food production. However, the Mali context, with one major buyer of cotton, may not be present in another context. Still, we believe that our framework, potentially with adaptations,

could be used to explore and assess co-ordination in and among value chains with other crops and in other countries. Another limitation of our study lies in the focus on co-ordination structures used for current transactions, without taking into account the dynamics of market structure.

Based on these insights, we suggest policy changes to empower smallholder farmers through the formation of strong farmer organizations for better co-ordination of transactions with buyers. Also, policy incentives favouring institutional innovations, such as insurance schemes and the provision of long-term credit and warehouse receipts, could facilitate a fairer balance of risks between smallholders and buyers. Additionally, the exposure of farmers to uncertainty and the impact on livelihood requires attention from policy-makers.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ACKNOWLEDGEMENTS

We thank the farmers and other value chain partners that participated in this research, and also the students who helped in data collection. We would like to thank the referee(s) for the constructive comments.

FUNDING

Financial support was received from the McKnight Foundation (Grant No. 19–310), through the project “Pathways to agroecological intensification in the crop-livestock farming systems in southern Mali”; the Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) programme provided additional financial support.

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How to cite this article: Dissa, A., Bijman, J., Slingerland, M., Sanogo, O. M., Giller, K. E. & Descheemaeker, K. (2022). Growing cotton to produce food: Unravelling interactions between value chains in southern Mali. *Development Policy Review*, 00, e12605. <https://doi.org/10.1111/dpr.12605>